

Final Remedial Investigation/Feasibility Study Work Plan

Bremerton Gas Works Superfund Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01
May 31, 2017

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Abbreviations

Anchor QEA	Anchor QEA, LLC
AOC	Administrative Settlement Agreement and Order on Consent for Remedial Investigation Feasibility Study
ARAR	applicable or relevant and appropriate requirement
Aspect	Aspect Consulting, LLC
AST	aboveground storage tank
bgs	below ground surface
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cascade	Cascade Natural Gas Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
City	City of Bremerton
COC	contaminant of concern
COPC	contaminant of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	conceptual site model
CSO	combined sewer overflow
CWA	Clean Water Act
DNAPL	dense non-aqueous phase liquid
DNR	Washington State Department of Natural Resources
DQO	data quality objective
DU	data usability
E&E	Ecology & Environment, Inc.
Ecology	Washington State Department of Ecology
EcoSSL	ecological soil screening level
EDD	electronic data deliverable
EM	electromagnetic
ENVVEST	Environmental Investment Project
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
ER-L	effect range-low
ER-M	effect range-medium
FS	Feasibility Study
GPR	ground-penetrating radar
HHRA	human health risk assessment
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
ISA	initial study area
KPHD	Kitsap Public Health District
Lent's	Lents and Blombergs
LNAPL	light non-aqueous phase liquid
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MCL	maximum contaminant level
MDAC	minimum data acceptability criteria
mg/kg	milligram(s) per kilogram
MGP	manufactured gas plant

MTCA	Washington State Model Toxics Control Act
NAPL	non-aqueous phase liquid
NOAA	National Oceanographic and Atmospheric Administration
NRHP	National Register of Historic Places
Order	Administrative Order for a Pollution Incident
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PHS	Priority Habitats and Species Program
PQL	practical quantitation limit
PRG	preliminary remediation goal
PSAMP	Puget Sound Assessment and Monitoring Program
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSL	regional screening level
SCO	sediment cleanup objective
Site	Bremerton Gas Works Superfund Site
SMS	Sediment Management Standards
SOW	Statement of Work
SPME	solid-phase microextraction
SQAPP	Sampling and Quality Assurance Project Plan
SVOC	semivolatile organic compound
TBA	Targeted Brownfields Assessment
TBC	to be considered
TCRA	time critical removal action
TEQ	toxic equivalent
TMDL	total maximum daily load
TOC	total organic carbon
TPH	total petroleum hydrocarbons
Tribe	Suquamish Tribe
TS	total solids
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
USCG	U.S. Coast Guard
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health

1 Introduction

Cascade Natural Gas Corporation (Cascade) is conducting a Remedial Investigation (RI) and Feasibility Study (FS) at the Bremerton Gas Works Superfund Site (Site) under the direction of the U.S. Environmental Protection Agency (EPA). This Final Remedial Investigation/Feasibility Study Work Plan (Work Plan) presents detailed descriptions of the procedures and activities to be performed to complete the RI/FS. This Work Plan was prepared as required by the Administrative Settlement Agreement and Order on Consent for Remedial Investigation Feasibility Study (AOC; EPA, 2013a) and accompanying Statement of Work (SOW) for the Bremerton Gas Works Superfund Site.

The Site, whose boundaries have not yet been defined, encompasses approximately 2.8 acres of industrial upland property and marine beachfront on the south shore of the Port Washington Narrows in Bremerton, Kitsap County, Washington. The Site location is depicted on Figure 1-1.

As an initial step in the RI/FS process, Cascade prepared a Final Scoping Memorandum (Aspect and Anchor, 2015; Scoping Memorandum) to identify the tasks necessary to conduct and complete the RI/FS. This Work Plan documents decisions and evaluations made during the scoping process and presents anticipated future tasks to complete the RI/FS. Following finalization of this Work Plan, a series of marine and upland field investigations will be conducted to gather data relevant to the Site.¹

The data collected during field investigations will be used to develop the Conceptual Site Model (CSM) for the Site, which will be presented together with the data in an RI Report. Concurrent with the RI Report, Cascade will prepare baseline risk assessments. Following finalization of the RI Report and the baseline risk assessments, a FS Report will be prepared that develops and evaluates potential remedies for the Site. EPA will use this information to develop a Proposed Plan. The phases of the RI/FS tasks are shown in the RI/FS Work Flow Chart (Figure 1-2).

A manufactured gas plant (MGP) formerly operated on a portion of the Site. Other historical uses on or near the Site include bulk petroleum storage and distribution, equipment storage, boat maintenance, metal fabrication, and automobile salvage. Previous investigations have identified elevated concentrations of hazardous substances in soil, groundwater, and sediments, attributable to these historical activities. Currently, portions of the Site are largely vacant and unused.

In accordance with the AOC and SOW, this Work Plan includes detailed sampling and quality assurance project plans. The Sampling and Quality Assurance Project Plan (SQAPP) for the upland and marine portions of the Site are included as Appendices A and B, respectively.

¹This Work Plan has been produced based on the current CSM which was developed using available information. The Cascade and EPA project teams may agree that elements of this Work Plan should change based on data collected during the RI. EPA must approve all changes to this Work Plan.

1.1 Objectives of the RI/FS

The objectives the RI/FS for the Site are the following:

1. Investigate and define physical, chemical and biological characteristics of the Site;
2. Define the sources, nature, and distribution of contaminants;
3. Provide sufficient information to calculate and assess the current and future potential risks to human health and the environment; and
4. Provide sufficient information to identify and evaluate remedial alternatives, conceptually design the remedial alternatives, and select a remedy.

The RI/FS will be conducted in accordance with the provisions of the AOC, SOW, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan, and EPA guidance, including, but not limited to, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA 1988a), and Guidance for Data Usability in Risk Assessment (EPA 1992).

Work undertaken throughout the RI/FS process will be conducted in coordination with key stakeholders and the public, with EPA serving in a lead role in those coordination efforts (see Section 9). The work will be conducted, not only in accordance with the legal requirements mentioned previously, but also consistent with other applicable EPA policies and practices, such as EPA's responsibility to consult with the Suquamish Tribe (Tribe) on a government-to-government basis, EPA's Tribal Policy, and EPA's guiding principles on Environmental Justice.

1.2 Work Plan Organization

This Work Plan is organized into the following Sections:

- Section 2 – Background and Setting. Section 2 provides a description of the Site location; a summary of known current and historical uses of the Site and adjacent properties and aquatic lands; a summary of the Site environmental setting including regional and Site geology and hydrogeology; a discussion of current demographics and land use; a summary of the characteristics of the Port Washington Narrows; and a description of natural and cultural resources in the Site vicinity.
- Section 3 – Initial Evaluation. Section 3 presents the regulatory requirements and provides a summary of the previous work conducted that is relevant to the RI/FS, including previous Site investigations, previous removal actions, and available existing data. A summary of the existing data for soil, groundwater, and sediment is also presented in this section.
- Section 4 – Preliminary Conceptual Site Model. Section 4 presents a conceptual understanding of the Site based on the information discussed in Sections 2 and 3, including a summary of the contaminants of potential concern, their sources, transport mechanisms, exposure pathways and receptors.
- Section 5 – RI/FS Approach. Section 5 presents the approach for completing the RI/FS and the rationale behind the approach, including identification of the data needs, a

summary of the risk assessment approach, a general discussion of the components of the upland and marine portions of the RI/FS, and potential contingent actions.

- Section 6 – RI Tasks. Section 6 presents a summary of the tasks to be conducted for completion of the RI.
- Section 7 – FS Planning. Section 7 presents a summary of the tasks to be conducted for completion of the FS. It also includes a discussion of potentially applicable remedial technologies for the Site, a summary of remedial approaches that have been implemented at similar sites, and the data needed to develop and evaluate remedial alternatives for the Site.
- Section 8 – Schedule. Section 8 presents the schedule for completion of the RI/FS including a field data collection schedule and the general schedule for subsequent tasks and reports.
- Section 9 – Project Management Plan. Section 9 presents the project management plan, including a data management plan.
- Section 10 – References. Section 10 presents a list of the references cited within this Work Plan.

2 Background and Setting

This Section describes the property upon which the former gas works was located and the properties surrounding the former gas works and discusses the operational and regulatory history of those properties.

2.1 Site Location and Description

The former gas works was located between Thompson Drive and Pennsylvania Avenue (Figure 2-1) on approximately 2.8 acres of property along the south shore of Port Washington Narrows in Bremerton, Washington. The historical street addresses for the former gas works included 1720 and 1800 Thompson Drive.

The real property upon which the former gas works was located (Former Gas Works Property) relative to current parcel boundaries is shown on Figure 2-1. Due to a boundary line adjustment in 1992, the Former Gas Works Property includes portions of two existing tax parcels:

- **Kitsap County Parcel No. 3711-000-0010-0409 (McConkey Property).** This parcel is owned by the McConkey Family Trust. The former gas works covered the entire parcel. No current or historical street address has been identified for this parcel.
- **Kitsap County Parcel No. 3741-000-022-0101 at 1701 Pennsylvania Avenue (Sesko Property).** This parcel is owned by Natasha Sesko. The former gas works covered the northwestern portion of this parcel.

The following properties are located near the Former Gas Works Property and have had either suspected or confirmed releases of contaminants from historical operations unrelated to the former gas works:

- **1723 Pennsylvania Avenue (Penn Plaza Property).** This property is owned by Penn Plaza Storage, LLC. There are multiple street addresses associated with this property, but it is listed in the Kitsap County assessor's database as 1723 Pennsylvania Avenue.
- **1701 Thompson Drive (Former ARCO Property).** This property is owned by Pipeworks Mechanical & Service, Inc. It is located southwest of the Former Gas Works Property, across Thompson Drive.
- **1702 Pennsylvania Avenue (Former SC Fuels Property).** This property is owned by NFS Properties 2, LLC. It is located east of the Sesko Property, across Pennsylvania Avenue.

The Port Washington Narrows is located north of the McConkey, Sesko, and Former SC Fuels Properties. The Port Washington Narrows consists of aquatic lands owned by the State of Washington and managed by the Washington State Department of Natural Resources (DNR).

2.2 Site Uses Prior to 1930

The Port Washington Narrows and the adjacent uplands are located in the traditional territory of the Suquamish Tribe, a Southern Coast Salish community speaking a dialect of the Southern Lushootseed language (Suttles and Lane, 1990). Shoreline locations in Dyes Inlet would have been available after stabilization of sea levels in the mid-Holocene (Thorson, 1980); therefore, Native American use of the area may date back 10,000 years. A variety of traditional activities took place in the general vicinity. In 1855, the Tribe signed the Treaty of Point Elliott, which ceded lands and established the reservation at Port Madison. The Tribe retained “the right of taking fish at usual and accustomed grounds and stations” (Treaty of Point Elliott, 1855), and the Port Washington Narrows is within the Tribe’s adjudicated Usual and Accustomed area.

2.3 Current and Historical Use and Operations

Historical use and operations on the properties and aquatic lands are based on historical records, including aerial photographs, interviews with current and former workers, owners, area residents, historical maps, deeds, Washington State Department of Ecology (Ecology) records, City of Bremerton (City) records, and DNR lease records. A number of historical documents are included in previous assessments of historical Site use (TechLaw, 2006; Hart Crowser, 2007). Available and relevant historical records are provided in Appendix C for reference.

Historical and current operations on the Former Gas Works Property (which consists of the entire McConkey Property and a portion of the Sesko Property) as well as historical and current operations on the other portion of the Sesko Property are described in Section 2.3.1. Historical and current operations on adjoining properties are described in Section 2.3.2.

2.3.1 Operations on McConkey and Sesko Properties

2.3.1.1 Former Gas Works Operations

In 1930, the Former Gas Works Property was developed as a gas works (a.k.a., manufactured gas plant, or MGP). Gas works were a common industry in large and small towns throughout the United States and Europe from approximately the mid-1800s to the mid-1900s. At a gas works, coal, coke, and/or petroleum products were heated in furnaces to produce manufactured gas, which was subsequently distributed via a gas piping network to the surrounding homes and businesses for heating, cooking, and lighting. Gas works used or generated several products and byproducts, including non-aqueous phase liquids (NAPLs) such as oils and tars, aqueous waste streams, and solid materials containing chemicals that may pose a risk to human health or the environment because they are toxic or carcinogenic (resulting in cancer effects). These contaminants include hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAHs), which can persist for a long time in the environment. Contaminant releases from historical gas works operations at other locations have resulted in sites where contamination remains in the subsurface as NAPLs, sorbed to soil or sediments or dissolved in the groundwater.

Because of the potential hazards posed by historical gas works facilities, these facilities are often the focus of state-led or federally led efforts to investigate and clean up contamination to protect human health and the environment. To characterize and remediate these facilities, it is important to understand traditional gas works operations, the types of contaminants that may be present, and where contaminants may have been released. This Section provides a summary of what is known about operations at the former gas works based on historical documentation and what is assumed based on typical gas works operations. This Section also identifies the contaminants usually associated with gas works feedstocks, fuels, and byproducts that may be present at the Site. Uncertainties about historical practices and potential releases will be addressed through field investigations as described in this Work Plan. Further discussion of potential release mechanisms and transport of contaminants in the subsurface is provided in Section 4, Preliminary Conceptual Site Model.

The operational history of the former gas works is as follows:

- **1930 to 1931.** The former gas works was constructed by the Western Gas and Utilities Corporation (Western).² It included a dock on aquatic lands initially leased from the DNR on November 25, 1930 (Former Gas Works Dock).
- **1931 to 1955.** Manufactured gas was produced using the carbureted water-gas process, from feedstocks of coal, coke briquettes, and petroleum products.³ In the 1940s, a standby plant for producing natural gas by blending liquefied petroleum (butane or propane) and air was installed. Gas produced at the Former Gas Works Property in the 1940s and 1950s was from manufactured gas and from butane-air. In 1952, the Former Gas Works Property was transferred from Western to Bremerton Gas Company, and in 1953 it was transferred to Cascade. In approximately 1955 (Simonson, 1997b), manufactured gas operations ceased, and all gas was produced from butane-air mixing.
- **1955 to 1963.** Natural gas was produced from butane-air mixing. In 1963, with the completion of a natural gas pipeline to the region, gas production ceased.
- **1963 to 1972.** Some of the structures and tanks were removed between 1964 and 1965, and the concrete piers supporting the tanks were jackhammered and hauled away (White 1998). The former plant building was reportedly used for pipe storage and, for a short time, magnesium mining research (*Bremerton Sun*, 1972). In 1972, the remaining structures, including the former plant building, were sold and dismantled.

In 1972, the Former Gas Works Property was acquired by Harold D. and L. Irene Lent and Theodore and Marian J. Blomberg, doing business as “Lent, Blomberg, Lent.” The Lent and Blomberg families operated several businesses near the Former Gas Works Property,

²In 1931, the Western Gas and Utilities Corporation changed its name to the Western Gas Company of Washington. The Western Gas and Utilities Corporation and the Western Gas Company of Washington are collectively referred to herein as “Western.”

³Typically, diesel-range fuel oils were used for petroleum feedstock for the carbureted water-gas process (Hatheway, 2012). However, one historical map (Sanborn, 1946) indicates that gasoline and fuel oil were stored in the northeast corner of the Former Gas Works Property.

including an oil distribution business on the Sesko Property under the name Lents, Inc. (see further discussion in Section 2.3.1.3). All entities and individuals associated with the Lents and Blombergs are referred to in this Work Plan as “Lent’s.”

In 1979, Paul and Margaret McConkey acquired most of the Former Gas Works Property. The McConkeys acquired the remainder of the Former Gas Works Property in 1985. A portion of the Former Gas Works Property was sold to William Sesko in 1992.

The summary of gas works operations provided in this Section combines available historical information about the layout and operations of the former gas works with information compiled from multiple sources regarding the operations of typical manufactured gas facilities, including generated byproducts and likely sources of releases of hazardous substances. Whereas this summary provides an overview of operations at the former gas works, it likely does not provide a complete picture of all sources, disposal areas, and spills and/or releases that may have occurred, which will be investigated primarily through the collection and evaluation of data as described in this Work Plan. Chemical feedstocks and potential byproducts typical of carbureted water-gas production⁴ include the following:

- **Feedstock and Fuels: Gasoline and Diesel Fuel Oil, Coal, or Coke Briquettes.** The contaminants potentially associated with feedstock and fuels include the following:
 - BTEX;
 - Naphthalenes; and
 - PAHs.
- **Byproducts: Light Oil, Carbureted Water-Gas Tar, Ash, Clinker, Slag, Soot, and Spent Purifier Filter Media.** The contaminants potentially associated with byproducts include the following:
 - BTEX;
 - Naphthalenes;
 - PAHs;
 - Phenols;
 - Other semivolatile organic compounds (SVOCs), including creosol, carbazole, and dibenzofuran.

Section 4.4 provides further discussion of the Site-specific COPCs.

⁴ Two byproducts typically generated at coal and/or oil gas plants, ammoniacal liquor and lampblack (carbon soot), were generally not generated in significant quantities by the carbureted water-gas process (Hatheway, 2012).

Production of natural gas using liquefied petroleum (butane or propane) blended with air is not anticipated to have resulted in contamination of the subsurface because butane and propane are gases at atmospheric conditions.

A flow chart showing the gas works process as understood at the Site (based on available plant maps and typical carbureted water-gas operations), including the production of byproducts, is presented on Figure 2-2. The locations of key plant features are shown on Figure 2-3. The general sequence of operations is as follows:

- **Product Delivery and Storage.** Solid feedstocks (coal and coke briquettes) were transported to the Site by barge and offloaded via a winch to a storage slab located in the northwest corner of the Former Gas Works Property. Petroleum products were also delivered to the former gas works via barge and conveyed via a pipeline up the Former Gas Works Dock to storage tanks located in the northeast corner of the Former Gas Works Property.
- **Gas Generation and Purification.** These operations were located in the north-central portion of the Former Gas Works Property (Figure 2-3). Two generator sets (furnaces) were located in the main plant building: one in the northern portion of the building and one in the middle of the building (Simonson, 1997b). The main plant building had a concrete floor (Simonson, 1997b). Coal and coke were placed in the generators and heated, and fuel oil was sprayed into the generators to produce gas. The resulting gas stream was then passed through a series of devices to cool the gas and remove impurities. These devices are described below:
- **Scrubber.** After gas generation comes clarification, in which tar is separated from the gas using a scrubber or similar equipment. These devices are typically located adjacent to the generator sets. A historical plant map shows the scrubber located directly west of the generator sets. A former plant worker indicated that the scrubber consisted of a tank with wooden slots and water to “wash out” the gas (Simonson, 1997b). An engineer’s report (Tymstra, 1942) indicates that wood chips and excelsior (i.e., wood shavings) were used to remove tar from the gas.

The clarification process typically produced tar, tar-soaked wood chips or shavings, gas liquor (aqueous solutions containing dissolved and suspended tar particles), and tar-water emulsions. Light oils may also have been produced in the scrubbing process. Tar-water emulsions from scrubbers were typically removed from clarification equipment and transported to residual management areas to separate tar from the water (Hatheway, 2012). The fate of byproducts and residuals is discussed in the bullet “Residuals Management.”

- **Gas Holder.** A large gas holder was located south of the scrubber, west of the main plant building. The bottom of the gas holder was reportedly 15 feet deep and contained tar and water (Simonson, 1997a). The materials used to construct the base of the gas holder are unknown.
- **Purifier.** Gas was passed through a bed of filter media to remove impurities such as sulfide from the gas. Typical filter media included wood chips and/or iron oxide. An engineer’s report (Tymstra, 1942) indicated that iron-oxide-covered chips were used at the gas works to remove sulfur compounds from gas. Multiple purifiers in parallel were typically installed to allow changeout of purifier media without interrupting the process

(Hatheway, 2012). Three purifiers were located at the Former Gas Works Property south of the large gas holder. In addition to the generation of spent purifier media, which included some accumulated tar (Tymstra, 1942), some liquid streams (including tar, gas liquor, and light oil) may have condensed during purification and were typically manually removed from the purifier box (Hatheway, 2012). The fate of these byproducts is discussed in the following bullet.

- **Residuals Management.** In addition to the gas produced by the manufactured gas process, residual materials were also produced and separated from the gas at several steps during the process. These residuals were intermediate waste streams typically managed on-Site and further processed to create byproducts for disposal or reuse. Residuals from the manufactured gas process included the following:
 - **Tar-Water Emulsion.** Tar removed from the gas stream, particularly from the condenser, was often a tar-water emulsion. Tar required a low water content to be saleable. Tar-water emulsions were typically removed from clarification equipment and transported to residual management areas to separate the tar from the water (Hatheway, 2012). Tar and water were typically separated by placing the emulsion in pits, cisterns, or tar wells (typically shallow boxes that may be lined or unlined) and allowing the tar to settle out. A former plant map shows tar wells and a residue cistern located west of the purifiers near the edge of the ravine adjacent to the former gas works (Former Ravine). A former resident recalled a tar pit located on the southwest corner of the Former Gas Works Property (Judd, 2014), and an engineer's report (Tymstra, 1942) noted, "The tar emulsion is dumped in shallow pits dug at random in the ground." A historical journal (Perry, 2002) indicated that the former gas works "had a pond for dumping surplus creosote-type fluids. This would overflow and the material would go into the channel." It is unknown how tar-water emulsions were transported to these areas or how tar was transported from these areas to the tar storage tank, which was located on the south side of the Former Gas Works Property.
 - **Storage, Distribution, and Disposal of Gas and Byproducts.** Following purification, finished gas was stored and distributed via underground piping to the gas service area. Finished gas and byproducts of the manufactured gas process were collected, stored, and used or disposed of as follows:
 - **Finished Gas.** Gas that had passed through the scrubbers and purifiers was pumped through compressors located in the engine room (south of the main plant building) and stored in finished gas storage tanks located south of the main operations area. Gas was piped from the finished gas tanks to the gas distribution system along an 8-inch-diameter gas main located in Thompson Avenue. Typically, in manufactured gas distribution systems, a minor amount of oil would condense within the initial section of distribution piping, which would be collected in a drip tank located near the facility (Hatheway, 2012). A drip tank located just south of the Former Gas Works Property (Figure 2-3) is shown on a historical plant sketch.
 - **Light Oil.** Light oils typically contain one- or two-ring aromatic compounds, such as BTEX, and naphthalenes, and have a density less than

that of water (i.e., light, non-aqueous phase liquids [LNAPLs]). Light oils were sometimes reused in the carbureted water-gas process. According to a former worker, light oils were produced in small quantities at the former gas works and stored in a tank south of the finished gas storage tanks. The worker recalled light oils were used as automotive fuel for workers' vehicles and were occasionally sprayed to control weeds in the southwest corner of the Former Gas Works Property (Simonson, 1997b).

- **Carbureted Water-Gas Tar.** This tar typically contains both light aromatics (e.g., BTEX) and semivolatile hydrocarbons. Semivolatiles in carbureted water-gas tar primarily consist of PAHs, but also include phenols and heterocyclic aromatics (i.e., carbazole or dibenzofuran). Carbureted water-gas tar is typically denser than water (i.e., dense non-aqueous phase liquids [DNAPLs]). According to a former worker (Simonson, 1997b), tar was a saleable product that was collected, stored in a tank on the south side of the Former Gas Works Property, and piped to barges at the Former Gas Works Dock. However, it is unlikely that all tar generated over the entire life span of the former gas works was recovered and sold in this manner, and some may have been accidentally spilled or released.
- **Gas Liquor.** Gas liquor is water containing dissolved and suspended tar and oil constituents. According to a 1942 report, gas liquor was reportedly discharged to the Port Washington Narrows through a drainpipe (Tymstra, 1942), but it is unknown if this practice continued for any length of time.⁵
- **Ash, Clinker, and Slag (Mineral Residue of Fuel and Feedstocks) from Furnaces.** Ash is generally powdery, whereas clinker is partially fused, and slag is fused. Some of these materials were reportedly placed on the bluff along the shoreline north of the Former Gas Works Property (Judd, 2014), and some may have been deposited in the Former Ravine.⁶
- **Soot from Furnaces.** According to a 1942 report, this material was reportedly placed in the Former Ravine near the oil storage tanks (Tymstra, 1942), but it is unknown if this practice continued for any length of time.
- **Spent Scrubber and Purifier Media.** When scrubber and purifier media such as tar-soaked wood chips and shavings were saturated, they were removed and replaced. Spent scrubber media contains tar, and spent purifier media often contains tar, sulfide, and cyanide compounds removed during purification, including Prussian Blue (an iron-cyanide compound) (Hatheway, 2012). According to a 1942 report, tar-soaked wood chips and excelsior produced on-site were reportedly placed in the Former Ravine near the oil storage tanks (Tymstra, 1942), but it is unknown if this practice continued for any length of time. An individual who worked at the

⁵ It is suspected that the drain pipe referred to in the 1942 report corresponds to the former outfall that was removed and plugged as part of the 2010 TCRA (see Section 3.3.1).

⁶ Boring logs for SP01 and MW04, which were located in the Former Ravine, indicate ash.

former gas works between 1953 and 1955 indicated that the spent purifier media were hauled off-Site (Simonson, 1997b).

2.3.1.2 Post-1972 Operations on the McConkey Property

Operations on the McConkey Property after the former gas works discontinued operations have included activities by Lent's between approximately 1972 and 1982, and industrial park operations by others from approximately 1982 to the present.⁷ Operations on the McConkey Property have included metal fabrication and sandblasting in the southern portion of the property, and parking and equipment storage across the other portion of the property. Two warehouse buildings are in the southern portion of the McConkey Property; the buildings are rented to separate tenants for storage of motor vehicles, vehicle parts, and associated mechanical equipment and tools. Historical and current operations on the McConkey Property are shown on Figure 2-4. A generalized process flow diagram of the metal fabrication process is shown on Figure 2-5.

Ecology inspected industrial park operations on the McConkey Property in 1992, 1993, 1994, and 1995, and observed the following activities during that period that may have resulted in contaminant releases:

- Improper storage of sandblast grit, solvents, and paint sludge at a metal-fabricating shop; and
- Debris and drums containing oily substances scattered around the industrial park.

2.3.1.3 Operations on the Sesko Property

The Sesko Property was used for bulk petroleum storage and distribution from as early as 1946 to no later than 1993, when the aboveground storage tanks (ASTs) were removed. Lent's was the primary operator of the tank farm on the Sesko Property. Former AST locations are shown on Figure 2-4. A process flow diagram of petroleum storage and distribution operations is provided on Figure 2-5. After 1993, the Sesko Property was used for boat maintenance, automobile salvage, equipment and debris storage, parking, and metal reclamation. The owner of the Sesko Property was involved in legal disputes with the City over nonconforming use of the Sesko Property (as a junkyard), violations of the Shoreline Management Act, and, in 2003, improper decommissioning of an underground storage tank (UST). Ecology spill records also indicate that approximately 25 gallons of gasoline were released to surface water from the Sesko Property in January 2003. Most of the equipment and debris has been removed, and the Sesko Property is currently vacant.

The Sesko Property includes remnants of the Former Ravine, which has been filled over the years. Fill activities have included the following:

- **Before 1930.** No records documenting fill activities before operation of the former gas works have been identified. However, based on a comparison of the 1919 shoreline (Figure 2-4) with an aerial photograph dated 1946 and sewer maps dated 1939, it appears that a portion of the Former Ravine was likely filled by the late 1930s, before

⁷ Based on City directory information, Lent's continued operating on the McConkey Property for at least 3 years after the McConkeys acquired most of the McConkey Property in 1979.

construction of a historical residence located on the Sesko Property and before construction of the Lent's tank farm.

- **1931 to 1955.** Aerial photographs and recorded observations (Tymstra, 1942; Judd, 2014) indicate that the western portion of the Former Ravine was filled between 1931 and 1955. Recorded observations indicate that people unaffiliated with the former gas works dumped miscellaneous garbage, trash, and fill in the Former Ravine before 1942. Residual materials from former gas works operations (i.e., soot, ashes, cinders, and tar-laden wood chips and shavings) were also reportedly dumped in the Former Ravine during this period (see Section 2.3.1.1).
- **1941 to 1974.** An easement granted by Western to the City gave the City the right to dump refuse, garbage, and ashes from an incinerator into the Former Ravine. The easement reserved the right for Western to dump ashes and cinders in the easement area, which included the eastern 25 feet of the Former Gas Works Property (most of which lies on the current Sesko Property). According to the City, the historical records that partially document this time period were destroyed in a fire, and any documents regarding construction of the incinerator or dumping of refuse, garbage, or incinerator ash into the Former Ravine would have been lost in that fire.
- **1968.** A DNR inspection reported that concrete and piping debris were placed in the Former Ravine (DNR, 1968).

Petroleum transfer lines that connected a dock located on the northern edge of the Sesko Property (Former Sesko Dock) to the Former ARCO Property and the Lent's tank farm were formerly located on the Sesko Property and may still be in place. An employee of the owner of the Sesko Property indicated that he had removed a portion of underground petroleum transfer piping he encountered in the northern portion of the Sesko Property. Petroleum transfer lines also reportedly connected the Former Sesko Dock to the Former SC Fuels Property to the east. Approximate pipeline locations, shown on Figure 2-4, were identified on construction plans for City sewer improvements (CH2MHill, 1982; MH&A, 1982).

2.3.2 Adjoining Properties

Surrounding properties include (1) the Penn Plaza Property, located to the south of the McConkey Property, (2) the Former ARCO Property, located to the west of the McConkey Property across Thompson Drive, and (3) the Former SC Fuels Property, located to the east of the Sesko Property across Pennsylvania Avenue (Figure 2-1). Historical and current operations on these properties are discussed in the following Sections.

2.3.2.1 Penn Plaza Property

There are five buildings on the Penn Plaza Property, which is used as an industrial park. Multiple tenants occupy the industrial park. Based on available records, the Penn Plaza Property has been used for commercial and/or industrial uses since the late 1930s or early 1940s. Prior to this time, an intermittent stream ran northeast across the Penn Plaza Property toward the Former Ravine on the current Sesko Property. This stream was reportedly used by area residents for dumping refuse and was filled in by 1942 (Judd, 2014).

Operations on the Penn Plaza Property have included Lent's operations from the 1940s to approximately 1985, and industrial park operations from approximately 1985 to the present.⁸ Lent's operations on the Penn Plaza Property included spray painting, metal plating, a pipe shop, truck repair, and parking for petroleum distribution.⁹ A former employee of Cascade, who worked in Bremerton in 1968 and 1969, recalled that wood treating may also have occurred as part of Lent's operations (Clapp, 1997). Since the cessation of Lent's operations, multiple tenants have used the Penn Plaza Property for industrial uses, including sheet metal fabrication, floating pier and acrylic septic tank manufacturing, concrete pipe/manhole manufacturing, heating and air conditioning repair, and marine propeller repair (TechLaw, 2006; Hart Crowser, 2007).

Ecology inspected operations at the Penn Plaza Property in 1992, 1993, 1994, and 1995, and identified the following activities that may have resulted in contaminant releases:

- A tenant reported to Ecology that an electroplating operation had made illegal discharges to a storm drain that resulted in a sewer backup.
- Ecology observed improper storage of waste concrete and waste oil at one of the tenant locations.
- Ecology observed diesel staining on the ground at another tenant location.
- Ecology observed debris and drums containing oily substances scattered around the industrial park.

On the north end of the Penn Plaza Property are oil and gasoline supply pipelines that connected the Former Sesko Dock with the Former ARCO Property to the west. The approximately location of these pipelines, based on a utility locate conducted during the time critical removal action (TCRA) in 2010, is shown on Figure 2-4.

2.3.2.2 Former ARCO Property

The Former ARCO Property was used for bulk petroleum storage and distribution from the mid-1940s to the late 1980s or early 1990s. Initially, 4 ASTs were present, with 2 added prior to 1956, 5 added in the late 1970s, and 4 added in the early 1980s for a total of 15 ASTs. Loading racks were located in the southeast corner of the Former ARCO Property. All tanks were removed by 1993. Property records indicate storage of gasoline, diesel, and oil. Product lines connected the ASTs on the Former ARCO Property with the Former Sesko Dock. Piping from the Former ARCO Property crossed the adjacent property to the north and ran west along the waterfront to a former dock (Former ARCO Dock) located approximately where the Port Washington Marina is today (see Section 2.3.3). According to a former resident, the piping to the Former ARCO Dock was located above ground (Judd 2014).

Since the early 1990s, the Former ARCO Property has been sporadically occupied by various tenants, including a tenant that conducted furniture refinishing and repair. The

⁸ Based on City directory information, Lent's continued operating on the McConkey Property for at least 3 years after the property was sold in 1979.

⁹ Petroleum for Lent's petroleum distribution was stored on what is now the Sesko Property.

Former ARCO Property is currently being used for commercial purposes by Pipeworks Mechanical and Service, Inc.

2.3.2.3 Former SC Fuels Property

The Former SC Fuels Property was used for bulk petroleum storage and distribution from the mid-1940s to the present. Operations on the Former SC Fuels Property are currently inactive. Initially, five ASTs were present, with one AST added prior to 1963, for a total of six ASTs. Four USTs were removed in 2003. Property records indicate storage of gasoline, diesel, and waste oil.

The Former SC Fuels Property is registered in Ecology's Voluntary Cleanup Program. A series of environmental investigations and remedial actions performed between 1997 and 2007 have confirmed releases of petroleum products and associated constituents, including gasoline, diesel, oil, BTEX, and PAHs. Additional information about the investigations and remedial actions is provided in Section 3.4.

Stormwater at the Former SC Fuels Property is collected in a series of catch basins, piped to an oil-water separator located at the top of the bluff, and discharged through an outfall to the Port Washington Narrows (Figure 2-4). Ecology conducted a Site visit in 2006, and noted a "gasoline odor" along the shoreline of the Former SC Fuels Property close to the stormwater outfall.

Pipes supplying petroleum to the Former SC Fuels Property tank farm ran from the Former SC Fuels Dock (see Section 2.3.3). An unknown number of petroleum transfer pipes also reportedly ran from the Former Sesko Dock to the tank farm on the Former SC Fuels Property, although their alignment is unknown (see Section 2.3.1.3).

2.3.3 Aquatic Parcels

Four docks were constructed in the aquatic parcels located adjacent (or closest to) to the properties described in Sections 2.3.1 and 2.3.2 (Figure 2-4). These aquatic parcels were leased from DNR. A description and brief history of each dock is included in the following Sections, and a detailed lease history prepared by DNR is provided in Appendix D.

2.3.3.1 Former Gas Works Dock

The Former Gas Works Dock was constructed by Western on November 25, 1930, as part of the development of the former gas works. It was located on the aquatic parcel adjacent and to the north of the Former Gas Works Property. The Former Gas Works Dock was used to offload coal, briquettes, and oil (via a 3-inch-diameter pipeline). Records indicate that the Former Gas Works Dock was also used to transfer heavy-end byproducts. In 1948, as part of the propane blending retrofit, the Former Gas Works Dock was updated to allow offloading of propane gas. Based on review of aerial photography, the Former Gas Works Dock was removed sometime between 1971 and 1974.

2.3.3.2 Former ARCO Dock

The Former ARCO Dock was constructed by the Richfield Oil Corporation in approximately 1942. It was located on the aquatic parcel immediately adjacent and to the

west of the aquatic parcel operated by the former gas works. The Former ARCO Dock served as both boat moorage and support for the pipelines associated with upland ARCO operations. It was removed by Richfield Oil's successor in the mid-1980s.

2.3.3.3 Former Sesko Dock

The Former Sesko Dock was constructed by Lent's in approximately 1942. It was located on the aquatic parcel immediately adjacent and to the east of the aquatic parcel operated by the former gas works. The Former Sesko Dock was used to support supply pipelines for barge delivery of diesel and stove oil, which were stored on the Sesko Property. During the 1970s and 1980s, the Former Sesko Dock was also used to supply the tank farm on the Former ARCO Property and the tank farm on the Former SC Fuels Property. In 1993, the pipelines on the Former Sesko Dock were removed. The Former Sesko Dock was removed in September 2001 pursuant to a DNR order.

2.3.3.4 Former SC Fuels Dock

The Former SC Fuels Dock was constructed by General Petroleum Corporation of California in 1942. It was located on the aquatic parcel immediately adjacent and to the east of the aquatic parcel where the Former Sesko Dock was located. The Former SC Fuels Dock was constructed for handling petroleum products. The Former SC Fuels Dock was removed in 1967 by Mobil Oil Corporation when barge deliveries of petroleum products were discontinued.

2.4 Environmental Setting

2.4.1 *Climate and Meteorology*

The Bremerton, Washington, area is dominated by a marine temperate climate with cool and comparatively dry summers and mild, wet, and cloudy winters (WRCC, 2014). The average annual high temperature for Bremerton is 60 degrees Fahrenheit (°F), and the average annual low temperature is 43°F (WRCC, 2014). Average annual precipitation is 52 inches, with nearly half of that occurring in November, December, and January (WRCC, 2014). During this wet season, rainfall is usually light to moderate in intensity and continuous over a period of time, rather than brief, heavy downpours. During the driest months of July and August, it is not unusual for 2 to 4 weeks to pass with only a few showers (WRCC, 2014). The prevailing wind direction in the region is south or southwest during the wet season and northwest in summer, with an average wind velocity of less than 10 miles per hour (WRCC, 2014).

2.4.2 *Topography and Drainage*

The Former Gas Works Property is located on a bluff on the south shore of the Port Washington Narrows. The Former Gas Works Property generally slopes gently to the north and is covered with buildings or pavement. At the northern edge of the Former Gas Works Property, a vegetated bluff slopes steeply down to the beach. Over time, the bluff has expanded to the north with the placement of fill material. Remains of the Former Ravine along the eastern edge of the Former Gas Works Property can be seen as a cove located at the northern edge of the Sesko Property. Stormwater drainage characteristics on the Former Gas Works Property and adjacent properties are as follows:

- **McConkey and Penn Plaza Properties.** Pavement covers most of the McConkey and Penn Plaza Properties, and the properties have catch basins connected to the City stormwater drainage system. A City stormwater and combined sewer overflow (CSO) outfall is located offshore, north of Pennsylvania Avenue. A catch basin in the northwest corner of the McConkey Property is connected to an outfall on the beach below the bluff.
- **Sesko Property.** Most of the Sesko Property is unpaved. Stormwater either infiltrates or runs off, presumably to the north toward the Port Washington Narrows.

2.5 Geology and Hydrogeology

2.5.1 Regional Geologic Setting

The Site lies within the Puget Lowland, an area that has alternated between glacial and interglacial environments during the last 2 million years. The result has been a stacked and imperfectly preserved sequence of glacial and nonglacial strata (Armstrong et al., 1965; Blunt et al., 1987; Booth et al., 2004a). This irregular stratification has been further impacted by the tectonics of the Seattle fault, a regional thrust fault system that extends through the area (Bucknam et al., 1992; Johnson et al., 1999; Blakely et al., 2002), including a strand through Oyster Bay (Washington DNR, 2014). The impacts of the fault system include uplift and tilting of bedrock and Quaternary strata in some areas and subsidence in others (Nelson et al., 2003; Kelsey et al., 2004).

Interglacial climates produced sediments much like the forested Puget Lowland before extensive development, with broad floodplains and gently sloping uplands. These deposits include silty to sandy floodplain sediments, scattered gravelly channel deposits, and peat and lacustrine (lake) sediments. Glacial climates resulted in rapid accumulation of glacial sediments and scour of preexisting landforms and deposits. These deposits include advance glacial lake (glaciolacustrine) deposits, advance outwash (glacial river deposits), glacial till (subglacial deposits), and recessional glacial deposits.

Bedrock crops out on the northern end of the peninsulas between Phinney Bay and Ostrich Bay, and elsewhere generally north and west of the Site (Washington DNR, 2014). Map data and limited deep well data suggest that bedrock generally dips to the south and west below the Site area (Eungard, 2014). This bedrock dip forms a regional basement aquitard (Jones, 1998). Some of the older sediments above bedrock are also likely tipped in this direction due to regional rotation along the Seattle fault (Booth et al., 2004b). Younger deposits, including those encountered in explorations for this project, are expected to be generally more horizontal but will include a number of discontinuous and irregularly shaped lenses of fine- and coarse-grained sediments that will impact the velocity and direction of groundwater flow. A conceptual geologic model of the Site area, including surficial geology (Figure 2-6) and subsurface geology (Cross Section AA–AA' on Figure 2-7) has been developed using regional map and well log data. Areas below the known exploration depths are shown as “undifferentiated.”

The conceptual regional hydrogeologic model is one of rainfall and infiltration on an upland covered generally with till and glacial outwash. Some of this water runs off as stormwater, while a portion infiltrates. The water that infiltrates (groundwater) will migrate more quickly through more-permeable strata and will be generally retarded by

less-permeable strata. The migration of water through these strata is influenced by the location and dip of the low-permeability strata (aquitards), as well as the location of waterways and other low-lying areas, which are often points of groundwater discharge. Regional patterns indicate that uplands are generally recharge areas, and slopes near sea level are discharge points. Groundwater also migrates from deeper strata and discharge upward into waterways.

2.5.2 Site Geology

Four principal geologic units have been identified based on previous explorations: fill, natural glacial deposits of the Vashon Drift, nonglacial deposits from one or more of the interglacial events that preceded the Vashon glaciation, and deposits from an older glaciation. The characteristics and distribution of these major sequences are described in this Section, from the stratigraphic top (generally younger) to the bottom. Note that these geologic interpretations are based on logs prepared by multiple geologists over the course of the prior investigations. Subsurface interpretations from these earlier explorations (e.g., fill characteristics or extent) may be refined later based on future observations.

The locations of the cross sections are shown on Figure 2-8, and four geologic cross sections are provided on Figures 2-9 through 2-12. Soil boring logs are provided in Appendix E. A description of the soils observed at the Site is provided in the following text.

Although fill was not specifically identified in many of the soil boring logs, it was apparently present in the majority of the previous explorations at the Site, in thicknesses ranging from a foot or less to about 15 feet. The thickest fill is present in the Former Ravine area on the Sesko Property. Fill is generally composed of brown to black, loose to very dense, or stiff to very stiff variable mixtures of silt and sand with variable amounts of gravel, coal fragments, asphaltic concrete, and other debris. The density and consistency of the fill was generally high for nonstructurally placed fills and may be due to inclusion of ash in the fill soils, which can produce slight cementation of soils.

Over most of the Site, glacial deposits were encountered beneath the surficial fill. The geologic maps of the Site indicate the glacial unit is the Vashon Drift. The soils encountered in the explorations generally consisted of clean (fines are absent) to silty fine- to medium-grained sand with trace to minor amounts of gravel and scattered interbeds of sandy silt. These glacial deposits were observed to be dense to very dense and were generally brown to gray. The gradation and density of this unit suggests that it is primarily Vashon advance glacial outwash. This unit has moderate permeability and, where saturated, will form an aquifer. The thickness of this unit at the Site ranges from 10 to 35 feet.

Pre-Fraser nonglacial deposits (predating the Vashon Glaciation) are present in the bluffs and uplands in the northeastern portion of the Site. Explorations encountered olive to gray and brown, stiff to hard silt to sandy silt with interbeds of very dense silty sand ranging in thickness from 2 to 10 feet. Thin interbeds or lenses of clay and silty clay and scattered gravelly layers may be present. This unit generally has low permeability; however, cleaner sandy layers may become saturated.

An older glacial sequence is present below the Vashon outwash and the pre-Fraser nonglacial deposits. The thickness of this unit has not been defined at the Site. The older glacial sequence consists of lenses or discontinuous layers of glacial till within an outwash-like brown to gray, very dense slightly silty to silty sand. The lenses of till are composed of brown to gray very dense silty gravel with sand and silty sand with gravel. The till lenses are generally considered an aquitard, but the outwash-like silty sand component was noted to be wet below about the 5- to 10-foot elevation, which probably reflects the regional water table. The scope of work for the RI, as described herein, will include additional investigations to determine whether the till acts as an aquitard at the Site.

2.5.3 Hydrogeology

Groundwater on the McConkey Property and Sesko Property was encountered at depths between 15 and 41 feet. Groundwater elevations have ranged between 3 and 10 feet above mean sea level, with an estimated flow direction to the north-northwest (to the Port Washington Narrows) during one sampling event (GeoEngineers, 2007b). Monitoring well construction details and groundwater elevation measurements are summarized in Table 2-1. Well construction logs are included in Appendix E.

Groundwater on the Former SC Fuels Property has been encountered at depths between 4 and 15 feet, with an estimated flow direction to the northwest. Groundwater on the Former SC Fuels Property appears to be perched within sandy zones present in generally low-permeability nonglacial soils.

The estimated directions of groundwater flow on the McConkey, Sesko, and Former SC Fuels Properties, based on previous studies, are shown on Figure 2-13. However, groundwater studies to date have not evaluated the effect of tidal influence on Site groundwater levels and flow direction. One-time groundwater elevation measurements are prone to error if tidal effects are significant.

2.6 Human Populations and Land Use

The Former Gas Works Property is in Bremerton, which is the largest city on the Kitsap Peninsula and home to Puget Sound Naval Shipyard and the Bremerton Annex of Naval Kitsap Base. According to the 2010 census, the population of Bremerton is 37,729 people with 1,328 inhabitants per square mile. The racial makeup of Bremerton is predominantly white/Caucasian (74%) with the rest of the population classified as “other” or two or more races (10.4%), African American (6.7%), Asian (5.5%), Native American (2.0%), and Pacific Islander (1.3%). According to the Tribe government website, the total population of the Tribe is 950 people.

The Former Gas Works Property is in an area of industrial-zoned properties that includes the Former ARCO Property and Former SC Fuels Property. Surrounding this industrial property core are residential properties and a marina. A zoning map is included on Figure-2-1. The Former Gas Works Property is immediately adjacent to intertidal sediments and surface water within the Port Washington Narrows, which can be accessed by the public.

2.6.1 Tribal Use

Tribal commercial, subsistence, and ceremonial fisheries have historically occurred in Dyes Inlet and the Port Washington Narrows. The Tribe has stated that “Suquamish tribal members fully intend to continue to fish these areas for cultural, subsistence and commercial purposes” (Suquamish Tribe, 2014). According to the Tribe, it “uses the Washington Commercial Shellfish Growing Area Classification to determine the suitability of bivalve harvests (i.e., claims, oysters)” (Suquamish, 2011). The marine area adjacent to the Former Gas Works Property is designated as “Unclassified” due to the proximity of CSOs, which precludes shellfish harvesting. However, according to the Tribe, the harvest of finfish and other marine invertebrates (i.e., crab and sea cucumber) are not restricted adjacent to the Former Gas Works Property (Suquamish, 2011).

2.6.2 Drinking Water Use

Water services at the Site and surrounding area are supplied by the City. The closest public water supply wells are located over one mile from the Site. The use of private wells within the Bremerton Water Service Area is not allowed, and there are no drinking water wells near the Site listed in Ecology’s database.

The Site is located adjacent to the Port Washington Narrows, a saltwater body. The extent of saltwater intrusion and the potability of Site groundwater, and its potential future use as a drinking water source will be evaluated as part of the RI.

2.7 Port Washington Narrows and Dyes Inlet

The Former Gas Works Property is located along the Port Washington Narrows, which is a tidal channel connecting Dyes Inlet to Sinclair Inlet and Puget Sound. Dyes Inlet is a terminal estuary, comprising five embayments (Phinney, Mud, Ostrich, Oyster, and Chico Bays) and the Port Washington Narrows (Figure 2-14).

The waters of Port Washington Narrows are relatively shallow, with average depths of less than 30 feet. Depths within Dyes Inlet range up to 100 feet, but are typically less than 50 feet. Area bathymetry is shown on Figure 2-14.

The shorelines of the Port Washington Narrows and Dyes Inlet have been extensively developed. These shorelines include the cities of Bremerton and Silverdale as well as the community of Tracyton. Other significant features include several former U.S. Navy facilities and regional transportation networks, including State Routes 3 and 303. The Warren Avenue and Manette Bridges are located across the Port Washington Narrows east of the Former Gas Works Property.

Hydrologic inputs to the Port Washington Narrows and Dyes Inlet include the tidal exchange with Sinclair Inlet and freshwater inflows from both stream and piped flows. Information from Kitsap County and the City regarding identified stormwater outfalls, CSO discharge points, and surface water inputs is summarized on Figure 2-14. Additional private and municipal outfalls may be present in addition to those identified by these information sources.

Hydraulic exchange between Dyes Inlet, the Port Washington Narrows, and the balance of Puget Sound is limited by the geography and the resulting hydrodynamics. In addition to

tide and current data available from public sources (e.g., National Oceanographic and Atmospheric Administration [NOAA]), the waters of Dyes Inlet and the Port Washington Narrows have been studied as part of regional water quality programs. Total maximum daily load (TMDL) studies and a contaminant mass balance evaluation have been performed for Dyes Inlet and may provide useful data for the RI/FS. Hydrodynamic modeling of the area has been performed as part of regional studies of Puget Sound. The results of additional studies are available to characterize environmental quality within Sinclair Inlet, immediately south of Dyes Inlet and the Port Washington Narrows. The Sinclair Inlet studies include extensive testing that has been performed in association with the Bremerton Naval Shipyard, as well as other regional study programs. These studies and evaluations are further addressed in Sections 3.5 and 3.9.

2.8 Natural Resources

This Section describes the natural resources of the upland areas, aquatic habitats, and related data needs for the RI/FS.

2.8.1 Upland Areas

The upland areas of the Former Gas Works Property and surrounding areas have been developed for industrial uses consistent with zoning provisions. However, some terrestrial and riparian habitat is present, particularly on the bank adjacent to the Port Washington Narrows, the Former Ravine, and the shoreline areas of the McConkey and Sesko Properties. The Washington Department of Fish and Wildlife (WDFW) manages a Priority Habitats and Species Program (PHS). Preliminary queries of WDFW's PHS system did not identify any priority terrestrial natural resources on the parcels associated with the Former Gas Works Property.


2.8.2 Aquatic Habitats

Aquatic habitats at the Site include those in the beach and subtidal areas within and near the Former Gas Works Property. Shoreline and aquatic habitat adjacent to the Former Gas Works Property are located within the Tribe's Usual and Accustomed area. Fish and shellfish resources are present within the waters of the Port Washington Narrows and Dyes Inlet. Fish and crab are known to be present and support commercial, recreational, and tribal fisheries. Shellfish harvesting within the Port Washington Narrows and Dyes Inlet has been restricted due to water-quality-related shellfish harvesting closures. However, efforts have been made by state and local governments, tribes, and other stakeholders to improve water quality in the area and reduce or lift these shellfish harvesting restrictions. A number of shellfish enhancement projects have been proposed within portions of Dyes Inlet. It is not known what measures have been undertaken by the Washington State Department of Health (WDOH) or the Kitsap Public Health District (KPHD) to monitor illicit shellfish harvesting within Dyes Inlet or the intertidal areas adjacent to the Site. Signage indicating the closure of the beach adjacent to the Former Gas Works Property was installed as part of the 2013 TCRA (see Section 3.3.2).

The query of the WDFW PHS identified two aquatic natural resources in the vicinity of the Former Gas Works Property: estuarine intertidal aquatic habitat along the northern and southern shorelines of the Port Washington Narrows and hardshell clams along the northern shoreline of the Port Washington Narrows.

2.9 Cultural Resources

There are no recorded archaeological sites or historic structures at the Former Gas Works Property or in the immediate vicinity. However, no cultural resources surveys have been conducted on the Site or in the vicinity prior to the present project. The documented archaeological sites nearest to the Former Gas Works Property include the following:

- (b)(3)
- 
- A number of ethnographic place names have been recorded at various locations along the Port Washington Narrows.

Kitsap County assessor's records (accessed January 2014) indicate that there is one building older than 50 years on the Penn Plaza Property—a warehouse constructed in 1955. The structure has not been evaluated for National Register of Historic Places (NRHP) eligibility. No impacts on this structure are anticipated during the RI/FS.

An archaeologist from Anchor QEA, LLC (Anchor) visited the project area in August 2013 to make a preliminary assessment of current conditions. The project area has been extensively modified in the historic and modern eras, with placement of fill materials and debris, and development and redevelopment of the Site for industrial uses. No native sediments, other than active beach deposits, were visible in the project area.

3 Initial Evaluation

This Section summarizes the regulatory requirements and existing data that supported the development of the preliminary conceptual site model (CSM), which is described in detail in Section 4.

3.1 Regulatory Requirements

This Section identifies initial applicable or relevant and appropriate requirements (ARARs), preliminary remediation goals (PRGs), and remedial action objectives (RAOs) for the purposes of project planning. Potential ARARs were identified to facilitate communications with support agencies, help plan potential field activities, and assist in the identification of RAOs and PRGs. Initial PRGs were identified to help evaluate existing data and assist in the selection of appropriate analytical methods. The ARARs, PRGs, and RAOs will be further developed during the RI/FS process. Those ARARs, PRGs, and RAOs that are determined to be applicable to the Site-related decisions may include some, none, or all of those identified in this Section. The ARARs, PRGs, and RAOs that are ultimately determined to be applicable to the Site-related decisions will be established in consultation and coordination with key stakeholders and the public during the RI/FS process.

3.1.1 *Applicable or Relevant and Appropriate Requirements*

The project must comply with CERCLA Section 121, which requires remedial actions to achieve ARARs. According to the National Contingency Plan (Code of Federal Regulations, Title 40, Section 300.5 [40 CFR 300.5]), applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental and facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance identified at a CERCLA site. Appropriate and relevant requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that are not applicable to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site, but address problems or situations similar to those encountered at the site that their use is well suited to the particular CERCLA site.

Some federal, state, and local environmental and health agencies may develop criteria, advisories, guidance documents, and proposed standards that are not legally enforceable but contain useful information for selecting cleanup levels or implementing a cleanup remedy. These fall into the category of “to be considered” (TBC) elements. TBCs are not mandatory requirements but may complement the identified ARARs.

ARARs and TBCs potentially relevant to the RI/FS are presented in Tables 3-1 through 3-3 and organized into the following categories:

- Contaminant-specific requirements;
- Location-specific requirements; and

- Performance, design, or other action-specific requirements.

Some ARARs fit neatly into a single category, whereas others may fall into more than one category. The categories are described as follows:

- Contaminant-specific ARARs are laws and requirements that establish health- or risk-based numerical values or methodologies for developing such values (EPA, 1988b). These ARARs are used to establish the acceptable concentration of a contaminant that may remain in or be discharged to the environment. As such, contaminant-specific ARARs are considered in identifying the PRGs. Contaminant-specific ARARs are listed in Table 3-1.
- Location-specific ARARs are requirements that are triggered based on the location of the remedial action to be undertaken (EPA, 1988b). Location-specific ARARs may restrict or preclude certain remedial actions or may apply only to certain portions of the Site. Some location-specific ARARs overlap action-specific ARARs. Location-specific ARARs are listed in Table 3-2. An example of a location-specific ARAR is the Point Elliott Treaty of 1855.
- Action-specific ARARs are performance, design, or other requirements that may place controls or restrictions on a remedial action (EPA, 1988b). Action-specific ARARs are typically technology- or activity-based requirements or limitations on actions, and these requirements may include contaminant-specific standards or criteria that must be met as the result of an action. For remedial actions at the Site, these requirements are not necessarily triggered by the presence of specific contaminants in Site media, but rather by the specific actions that occur at the Site. Action-specific ARARs are listed in Table 3-3.

3.1.2 Remedial Action Objectives

RAOs consist of goals for protecting human health and the environment that are specific for each potentially contaminated environmental medium (e.g., soil, groundwater, and sediment). RAOs for protection of human receptors typically include both a contaminant level and an exposure route. RAOs for protection of environmental receptors typically seek to preserve or restore a resource and are typically expressed in terms of the medium of interest and target cleanup levels. The preliminary RAOs related to the protection of human health are as follows:

- **Groundwater.** Reduce risk to human health from direct contact with, and consumption of, groundwater contaminated with Site-related contaminants of concern (COCs)¹⁰ to protective levels.
- **Biota.** Reduce risks associated with consumption of contaminated fish and shellfish to protective levels by reducing concentrations of site-related COCs in sediments. It is assumed that this will reduce concentrations in aquatic resources.

¹⁰ Under CERCLA guidance, those COPCs identified as posting unacceptable risk during the baseline risk assessment should be retained as contaminants of concern (COCs) for further evaluation of remedial options during the FS stage of the RI/FS.

- **Sediment.** Reduce to risk to human health from incidental ingestion and/or dermal exposure to Site-related COCs during potential recreational use of the beach areas at the Site to protective levels.
- **Vapor.** Reduce risk to human health from inhalation of vapors from groundwater and/or soils contaminated with Site-related COCs to protective levels.
- **Soils (Surface and Subsurface).** Reduce risk to human health from direct contact with or incidental ingestion of Site-related COCs to protective levels.

The preliminary RAOs related to environmental protection are as follows:

- **Groundwater.** Reduce, to protective levels, risks to ecological receptors from direct contact with and consumption of groundwater contaminated with Site-related COCs that discharges to surface water at the shoreline, including indirect exposure from consumption of prey exposed to groundwater discharging to surface water.
- **Groundwater.** Reduce, to protective levels, migration of contaminants in groundwater to surface water or sediments.
- **Upland Soil.** Reduce, to protective levels, risks to terrestrial wildlife exposed to Site-related COCs through direct contact with and incidental ingestion of Site soil or consumption of soil-dwelling invertebrates.
- **Sediment.** Reduce, to protective levels, risks to aquatic wildlife from exposure to Site-related COCs in surface sediments or in prey species at the Site.
- **Sediment.** Reduce, to protective levels, risks to the benthos from Site-related COCs in surface sediments.

The preliminary RAOs will be developed further throughout the RI/FS process, in consultation with key stakeholders and the public, and may be revised, refined, or replaced.

3.1.3 Preliminary Remediation Goals

This Section identifies PRGs for the initial screening of existing soil, groundwater, and sediment data. The purpose for PRGs is to establish a preliminary screening level, based on ARARs, to evaluate investigation results. PRGs can be updated throughout the RI/FS process and any PRG screening does not affect the identification of COCs. Surface water initial PRGs have been identified to assist in the development of this Work Plan; however, no surface water data are available for the Site. The initial PRGs were used in the development of the SQAPPs (Appendices A and B) to select appropriate analytical methods.

Potential PRGs include numerical values identified in ARARs, peer-reviewed risk-based values, or values identified in other screening benchmark sources. Potential PRGs include values from the following sources:

1. ARARs:

- Soil: none available (except for those related to polychlorinated biphenyls (PCBs) in the Toxic Substances Control Act);
- Groundwater: maximum contaminant levels (MCLs);

- Surface water: Washington State-specific and EPA human health criteria (organisms only) promulgated under Section 303(c) of the Clean Water Act (CWA) (EPA, 2016) and national recommended water quality criteria for human health (organisms only) and -aquatic life (acute and chronic)¹¹; and
- Sediment: Washington State Sediment Management Standards (SMS).

2. Peer-reviewed sources:

- Soil: EPA human health regional screening levels (RSLs) and EPA ecological soil screening levels (EcoSSLs);
- Groundwater: EPA human health RSLs;
- Surface water: none available; and
- Sediment: NOAA effect range-low (ER-L) and effect-range-medium (ER-M) benchmarks (Long et al., 1995).

3. Other screening benchmark sources:

- Soil: EPA Region 5 Resource Conservation and Recovery Act (RCRA) EcoSSLs
- Groundwater: none available;
- Surface water: EPA Region 3 Biological Technical Assistance Group (BTAG) ecological surface water screening benchmarks and EPA Region 5 RCRA ecological surface water screening levels; and
- Sediment: EPA Region 3 BTAG ecological sediment screening benchmarks and EPA Region 5 RCRA ecological sediment screening levels.

Tables 3-4, 3-5, 3-6, and 3-7 summarize the potential PRGs from these sources for each medium (soil, groundwater, sediment, and surface water, respectively) and identify an initial PRG for each contaminant. The initial PRG for a given contaminant was selected as the lowest of the ARARs or peer-reviewed risk-based criteria. If a value from these first two sources is unavailable, the initial PRG was selected as the lowest value in the “other screening benchmark” category. For sediment, the SMS value was used. If no SMS value exists for the contaminant, the peer-reviewed NOAA value was used.

For soil, two different initial PRGs were identified: one for surface soil to a depth of 0- to -3 feet below ground surface (which includes a consideration of screening levels for terrestrial ecological receptors from 0- to 1-foot, and upland construction worker exposure scenario of 0- to 3-feet) and one for subsurface soil at depths below potential ecological exposures and construction worker scenarios. The initial PRGs include the following:

- Soil:
 - EPA RSLs – residential
 - EPA RSLs – industrial

¹¹ The National Toxics Rule (NTR) 40 CFR131.36 establishes chemical-specific numeric criteria for priority toxic pollutants for certain states. Washington has been withdrawn from the NTR for those state-adopted criteria approved by EPA (EPA, 2016) but the NTR remains an ARAR for other criteria. However, for this project there are no compounds with NTR criteria that do not have state-adopted criteria so the NTR criteria are not included.

- EPA EcoSSLs – birds
 - EPA EcoSSLs – mammals
 - EPA EcoSSLs – invertebrates
 - EPA EcoSSLs – plants
 - EPA Region 5 RCRA EcoSSLs
- Groundwater:
 - EPA MCLs
 - EPA RSLs – tap water
- Sediment:
 - Washington State SMS sediment cleanup objectives (SCOs);
 - NOAA ER-L benchmarks (Long et al., 1995);
 - EPA Region 3 BTAG ecological marine sediment screening benchmarks; and
 - EPA Region 5 RCRA ecological sediment screening benchmarks.
- Surface water:
 - National recommended water quality criteria for human health (consumption only) and aquatic life (EPA, 2013b);
 - EPA Region 3 BTAG ecological marine surface water screening benchmarks;
 - EPA Region 5 RCRA ecological surface water screening levels; and
 - CWA-Effective criteria for the protection of human health (consumption of organisms) (EPA, 2016).

4. Risk-based PRGs for Seafood Consumption

PRGs based on seafood consumption will be developed in consultation with EPA and the Tribe. The PRGs will consider potential risks to tribal members who consume fish and/or shellfish from the Site. The PRGs for these exposure scenarios will be developed in the Risk Assessment Technical Memorandum (see Section 5.3.1).

3.2 Previous Site Investigations

Previous environmental field investigations at the Former Gas Works Property include the following:

- Sesko Property Field Inspection (Ecology, 1995);
- Preliminary Upland Assessment, McConkey and Sesko Properties (GeoEngineers, 2007b); and
- Targeted Brownfields Assessment (TBA), McConkey and Sesko Properties (E&E, 2009).

The upland exploration locations and sampling depths by analyte group are provided on Figure 3-1. The scope and general conclusions of each study are described in the following Sections.

3.2.1 Ecology Field Inspection (1995)

In 1995, Ecology collected three surface soil samples from the Sesko Property and one surface sediment sample from the tidelands just north of the Sesko Property. The samples were analyzed for metals and SVOCs. High concentrations of PAHs were detected. Ecology used the data in conducting a Site Hazard Assessment and gave the Site a ranking of “1” (highest concern).

3.2.2 Preliminary Upland Assessment (2007)

In 2007, on behalf of the City and funded by a brownfield grant from EPA, GeoEngineers conducted a preliminary assessment of the McConkey and Sesko Properties (GeoEngineers 2007a) that included the following:

- Advancing eight soil borings and collecting soil samples to a maximum depth of 45 feet;
- Installing monitoring wells at each of the eight soil boring locations and collecting groundwater samples; and
- Analyzing soil and groundwater samples for total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), SVOCs, PCBs, and metals.

This work identified relatively high concentrations of gasoline- and diesel-range TPH, VOCs including benzene, and PAHs in soil and groundwater on the McConkey and Sesko Properties. VOCs and PAHs were detected in soil samples at depths up to 35 feet. Several metals, including arsenic, lead, and chromium (including chromium VI), were detected in groundwater at concentrations greater than the potential drinking water cleanup standards.

3.2.3 Targeted Brownfield Assessment (2008)

In 2008, on behalf of EPA, Ecology & Environment, Inc. (E&E) conducted a TBA of the McConkey and Sesko Properties (E&E, 2008) that included the following:

- Advancing seven soil borings and collecting soil samples to a maximum depth of 45 feet;
- Installing monitoring wells at two of the seven boring locations;
- Collecting groundwater samples from the two wells and from temporary screens placed at four of the seven soil boring locations;
- Collecting five surface sediment samples from the beach north of the properties;
- Analyzing soil, groundwater, and sediment samples for TPH, VOCs, SVOCs, and metals.

Similar to the Preliminary Upland Assessment, this work identified relatively high concentrations of gasoline- and diesel-range TPH, VOCs including benzene, and PAHs in soil and groundwater on the McConkey and Sesko Properties. The assessment also identified relatively high concentrations of PAHs in surface sediments. VOCs and PAHs were detected in soil samples at depths up to 45 feet.

3.3 Previous Site Removal Actions

Two TCRA's have been performed at the Site as described in this Section.

3.3.1 Time Critical Removal Action (2010)

In August 2010, sheens on the surface water of the Port Washington Narrows were reported to KPHD. Upon further investigation, KPHD identified a 12-inch-diameter concrete pipe that appeared to be the source of the sheen. The pipe is believed to be an abandoned City CSO outfall. KPHD reported the release to EPA, which in turn notified the U.S. Coast Guard (USCG) for a response because the pipe was within its jurisdiction. In 2010, at the request of EPA, E&E conducted sampling and analysis as part of the EPA and USCG's initial response. The response sampling included the collection of 32 surface sediment samples from a depth of 0 to 6 inches. The sediment samples were analyzed for VOCs and SVOCs, both of which were detected.

EPA, DNR, KPHD, and Ecology entered into a USCG-led coordinated response under a Unified Command Structure. Cascade became aware of the response in October of 2010 and informed the USCG that it was interested in contributing to the response. USCG subsequently added Cascade to the Unified Command Structure and issued Cascade an Administrative Order for a Pollution Incident (Order) to implement response actions at the Site under the oversight of USCG. Cascade accepted the Order in a letter dated October 29, 2010.

In response to the Order, Cascade developed an Incident Action and TCRA Work Plan (Anchor QEA and Aspect 2010), which outlined the scope and details of the 2010 TCRA. The 2010 TCRA included the following key elements:

- Investigation of the location and orientation of the abandoned pipe;
- Permanent plugging of the pipe as close as practicable to the shoreline;
- Removal of all portions of the pipe from the new plug to the terminus of the pipe;
- Backfilling of the excavation created by removal of the pipe with clean beach material;
- Placement of an organoclay mat over impacted sediments (with minimal disturbance) near the terminus of the pipe that were observed to generate sheen; and
- Continued maintenance of a containment system until field observations and inspections confirm that the situation is stable (no sheen).

On November 5, 2010, USCG and the other members of the Unified Command Structure approved the Incident Action and TCRA Work Plan. Cascade commenced the 2010 TCRA immediately upon approval and completed the 2010 TCRA on November 8, 2010.

(Anchor QEA, 2011). The removal action satisfied the following objectives of the Incident Action and TCRA Work Plan:

- The pipe was located and traced to the shoreline.
- The pipe was plugged as close as practicable to the shoreline, at the location specified in the Incident Action and TCRA Work Plan.
- All pipe sections downgradient of the new plug were removed together with all overburden sediments.
- All excavations were filled to grade with clean beach material.
- The organoclay mat was placed over the area of impacted sediments specified in the Incident Action and TCRA Work Plan.

Inspections of the 2010 TCRA area were completed as specified in the Incident Action and TCRA Work Plan. The inspections consisted of visual observation of the ground surface at the pipe plug area and the overlying organoclay mat to identify any potential surface sheen. Following completion of the removal action, inspections were performed at decreasing intervals over time, starting at biweekly intervals and decreasing to quarterly intervals. Inspections have continued on a quarterly basis. No surficial sheens related to the 2010 TCRA have been observed to date. The constructed elements of the 2010 TCRA are shown on Figure 3-2.

3.3.2 Time Critical Removal Action (2013)

In 2013, Cascade completed a removal evaluation pursuant to the requirements of the AOC and the EPA-approved Removal Evaluation Work Plan (Anchor QEA and Aspect, 2013a). The objective of the removal evaluation was to assess whether suspected migration pathways at the Site pose a threat to human health, welfare, or the environment if left unaddressed before completion of the RI/FS. The results of the removal evaluation were reported in the EPA-approved Removal Evaluation Report (Anchor QEA and Aspect, 2013c). The removal evaluation identified the following conditions that warranted action before completion of the RI/FS:

- **Stormwater intrusion into Manhole A.** Manhole A was believed to remain connected to the 12-inch-diameter concrete pipe that was plugged as part of the 2010 TCRA. Based on inspections conducted as part of the removal evaluation, it was determined that stormwater could have been entering Manhole A through surface runoff or via a piping connection to Manhole A from a nearby sump. Stormwater entering Manhole A posed a risk of hydraulically surcharging the pipe plugged during the 2010 TCRA, which in turn could have increased the risk of a hazardous substances release to the Port Washington Narrows.
- **Hydrocarbon sheen and deposits of solid hydrocarbon material in SG-04/SG-05 Area.** Hydrocarbon sheens were observed in shallow subsurface sediments in the western area of the beach, near sampling stations SG-04 and SG-05. Surficial solid hydrocarbon material was also observed in the SG-04/SG-05 area. Both the sediments containing hydrocarbon sheen and the solid hydrocarbon material contained concentrations of PAH compounds that were elevated in comparison to those of the surrounding beach sediments.

The Removal Evaluation Report proposed the following removal actions in response to the identified conditions:

- **Plugging the connections to Manhole A.** This action was intended to minimize the risk of hydraulic surcharge to the pipe plug, thereby minimizing the risk of hydrocarbon releases from the pipe.
- Remove the accessible solid hydrocarbon material and place a cap over sediments containing hydrocarbon sheen in SG-04/SG-05 area. These actions were intended to minimize the risk of additional releases of hydrocarbons from this area to surface waters of the Port Washington Narrows and to prevent direct contact with these materials by beach users.
- **Install signage.** The purpose of the signs is to warn beach users about the presence of hydrocarbon contaminants in the beach sediments and provide agency contact information regarding the Site and the ongoing RI/FS process.

Upon completion of the removal evaluation, Cascade prepared a work plan describing the proposed removal actions in more detail. EPA approved the Final Removal Action Work Plan (Anchor QEA and Aspect, 2013b) and directed Cascade to perform the proposed removal actions (EPA, 2013c). After EPA's approval, Cascade implemented the removal action (2013 TCRA), which met all of the objectives specified in the Final Removal Action Work Plan including the following:

- Removing solid hydrocarbon material identified in the western beach area;
- Installing an organoclay mat and cover over the hydrocarbon sheen in subsurface sediments in the western beach area;
- Plugging Manhole A and the sump drain from the tank containment area;
- Completing monitoring inspections to confirm the effectiveness of the 2013 TCRA; and
- Installing required signage.

The work was completed in general accordance with the Final Removal Action Work Plan and documented in the TCRA Removal Action Report (Anchor QEA and Aspect, 2014). Three modifications to the scope of work specified in the Final Removal Action Work Plan were made with EPA approval based on the observed conditions:

- The organoclay mat and cover in the northeastern portion of the designed mat and cover area was extended to cover sediments exposed by the removal of the solid hydrocarbon material from the intertidal area.
- Manhole A was plugged by means of a concrete ring extending above the ground surface and capped with a bolted steel cover.
- Consistent with approvals from the City and pursuant to an access agreement with Penn Plaza Storage, LLC, a catch basin draining into the tank containment area was rerouted to a City storm drain line to prevent accumulation of stormwater in the containment area.

Inspections of the 2013 TCRA areas were completed as specified in the Final Removal Action Work Plan (Anchor QEA and Aspect, 2013b). The inspections consisted of visual

observation of the sediment cap and surrounding intertidal areas for the presence of product or sheen on the sediment or nearshore surface water and evaluation of the sediment cap for erosion. The inspections also included inspection of the manhole and tank containment areas to ensure that the plugs are intact and that surface water is not accumulating in these areas. Following completion of the removal action, inspections were performed at decreasing intervals over time, starting at weekly intervals and/or following significant precipitation events, and decreasing to quarterly intervals. Inspections have continued on a quarterly basis. To date, the constructed elements of the 2013 TCRA have been performing as designed with no surficial sheens observed in the organoclay mat area and no surface water accumulation in the manhole or tank containment areas. The constructed elements of the 2013 TCRA are shown in Figure 3-2.

3.4 Other Upland Investigations and Remedial Actions

Investigations and remedial actions conducted at other locations in the immediate vicinity of the Site may be relevant to characterizing the Site or understanding area-wide conditions. The only known upland investigations or remedial action performed in the immediate vicinity of the Site are those conducted at the Former SC Fuels Property.

Between 1997 and 2007, various consultants performed soil and groundwater sampling at the Former SC Fuels Property (Pacific Environmental, 1997; Noll, 1999 and 2000; GeoEngineers, 2002 and 2003; and GeoScience Management, 2007), including the following:

- Advancing 13 hand-auger borings, 18 direct-push soil borings, and 15 hollow-stem-auger borings to a maximum depth of 22 feet;
- Installing 15 monitoring wells to a maximum depth of 20 feet;
- Collecting 12 soil confirmation samples during removal of four USTs; and
- Analyzing soil and groundwater samples for TPH, BTEX, and/or lead.

The investigations indicated the presence of TPH and BTEX in soil and groundwater on the Former SC Fuels Property and in the eastern portion of the Pennsylvania Avenue right-of-way. The TPH and BTEX concentrations exceeded Washington State Model Toxics Control Act (MTCA) Method A cleanup levels.

3.5 Other Sediment Investigations and Remedial Actions

In addition to the sediment data developed as part of previous investigations and remedial actions at the Site, other data sets have been compiled. The studies completed within the Port Washington Narrows and Dyes Inlet may provide information relevant to the RI/FS. Studies identified to date for these areas include the following:

- Chemical testing of sediments:
 - 2008 and 2009 Puget Sound Assessment and Monitoring Program (PSAMP) Spatial/Temporal Monitoring, Central Sound (PSAMP, 2005 and 2009);
 - 1989 to 2013 PSAMP Long-Term/Temporal Monitoring (PSAMP, 2005 and 2011a);

- 2009 PSAMP Urban Waters Initiative, Bainbridge Basin (PSAMP, 2005, 2009, and 2011b); and
 - Ocean Survey Vessel *Bold* Summer 2008 Survey (USACE et al., 2009).
- Chemical testing of fish or shellfish tissue:
 - 2010 and 2012 Environmental Investment Project (ENVVEST) (Johnston et al., 2010; Brandenberger et al., 2012);
 - 2005 and 2007 NOAA Mussel Watch at station SIWP (Lauenstein and Cantillo, 1993; Kimbrough and Lauenstein, 2006; Kimbrough et al., 2006; and Kimbrough et al., 2008); and
 - 2001 303d Ecology clam and crab sampling data (Ecology, 2002).
- Studies of surface water quality:
 - An Integrated Watershed and Receiving Water Model for Fecal Coliform Fate and Transport in Sinclair and Dyes Inlets, Puget Sound, Washington (Johnston et al., 2009); and
 - Sinclair and Dyes Inlets Fecal Coliform Total Maximum Daily Load: TMDL and Water Quality Implementation Plan (Lawrence et al., 2012).
- Regional studies of contaminant source inputs to these water bodies:
 - Contaminant Mass Balance for Sinclair and Dyes Inlets, Puget Sound, Washington (Crecelius et al., 2003).

Evaluation of this sediment and tissue data is discussed further in Section 3.9.

3.6 Existing Data and Data Usability

The existing Site characterization data have been reviewed in terms of data usability for the RI/FS. The existing data include data for the Former Gas Works Property and also data for sediments and tissue within the Port Washington Narrows, Dyes Inlet, and nearby portions of Puget Sound.

Data quality review included the definition of minimum data acceptability criteria (MDAC). Relevant guidance was applied, including the following:

- EPA (1988a) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA;
- EPA (1992) Guidance for Data Useability in Risk Assessment, Part A;
- EPA Contract Laboratory Program Functional Guidelines for Data Review (variable dates for different analyte groups); and
- EPA (2009) Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.

3.6.1 Minimum Data Acceptability Criteria

The MDAC evaluations of historical soil, groundwater, and sediment investigations are described for each sampling event in Table 3-8.¹² MDAC evaluations of existing sediment

¹² Investigations conducted under the Order for the Site and performed in accordance with EPA-approved Quality Assurance Project Plans (i.e., the 2013 TCRA) are not included in the MDAC tables.

and tissue investigations are described in Table 3-9. This MDAC review considered the following criteria:

- Work Plan Documentation:
 - Documentation describing the sampling program or event, the methods used, and the parties involved in sample collection must be available.
 - Collection methods must be clearly defined and be adequate for obtaining representative and quantitative information.
 - The purpose of data collection should be available.
- Sample Location and Collection Methods:
 - Sample coordinates and a qualitative understanding of accuracy (i.e., knowledge of how the location was established or the method by which the coordinates were obtained) must be documented. The coordinate system must be documented.
 - Sample collection method and matrix must be documented. For example, a water sample must be identified as to whether it is a surface water, porewater, or groundwater sample and whether it is whole water or filtered (i.e., total versus dissolved fraction). Temporal or spatial compositing and sample volume must be identified. For tissue samples, tissue preparation must be documented.
 - Sample depths and, where applicable, start and end depths must be identified.
 - Sample storage methods must be documented and consistent with approved methods, including holding time and preservation.
 - Sample chain of custody must be documented.
- Laboratory Analysis:
 - Data tables are available (not in summary format) with laboratory reports and data validation information.
 - Appropriate detection limits and quantitation limits are achieved so that the data meet the RI data quality objectives (DQOs) for environmental investigations:
 - Detection limits, units for each detection limit, and data qualifiers must be reported. Nondetected results must have the associated detection or reporting limits indicated. Data qualifiers must follow EPA guidance or be defined in documentation.
 - Analytical methods must be documented and acceptable based on EPA guidance.
 - Measurement instruments and calibration procedures must be documented.
 - Toxicity and bioaccumulation test methods must be documented, including any deviations from standard protocols. For risk assessment, test methods must follow standard protocols, including controls and reference tests. Proper documentation to assess methods and statistical treatment must be available. Where

possible, statistical results should be recalculated from the raw test data.

- Taxonomic data must be reported to the lowest practicable taxonomic level on a sample-specific basis, with scientific nomenclature. Taxonomic levels must be sufficient to assess relevant metrics for ecological risk assessment (ERA), such as feeding guilds or stress-induced compositional changes in the community.
 - Collection methods, sample preservation, and sample preparation methods must be documented.
 - Biological community metric calculations must be defined and documented.
- Quality Control and Data Validation:
 - Documentation of field and laboratory quality control samples (duplicates and blanks) must be present.
 - Analytical chemical data must have been validated and qualified consistent with EPA functional guidelines or EPA Region 10 validation practices.
 - Hard copies of laboratory data reports (e.g., Form 1 or Certificates of Analysis) must be available to verify that electronic or tabulated data were accurately transcribed or transmitted.

3.6.2 Data Usability

Based on the results of the MDAC evaluation and considering the data representativeness for current Site conditions, the data were classified in one of the following data usability (DU) categories:

- **DU-1.** These data meet most or all of the MDAC requirements and are considered reasonably representative of Site conditions. DU-1 data are used in this Work Plan for COPC and source identification and preliminary evaluations of the nature and extent of contamination. These data may also be useful in the identification of data gaps and data needs, such as the mussel, clam, and crab results presented in this Work Plan.
- **DU-2.** These data meet most of the MDAC requirements but have been superseded by more current or higher quality data for representation of the nature and extent of contamination. If no DU-1 data is available (e.g., 2010 surface sediment results underlying the TCRA cap.), then DU-2 data are used in this Work Plan for COPC identification, source identification, and the preliminary evaluations of the nature and extent of contamination,
- **DU-R.** These data do not meet the MDAC requirements and are not used in this Work Plan.

Of the existing data, the data were classified as follows:

- DU-1:
 - All data collected during the 2013 TCRA.

- Soil data, sediment data for analytes other than PAHs, and groundwater data from monitoring wells, collected during the 2008 TBA.
- Soil and groundwater data collected during the 2007 Preliminary Upland Assessment. These data met most of the MDAC criteria but underwent minimal data validation.
- Sediment monitoring data collected under the following programs:
 - 2008 and 2009 PSAMP Spatial/Temporal Monitoring, Central Sound;
 - 1989 to 2013 PSAMP Long-Term/Temporal Monitoring;
 - 2009 PSAMP Urban Waters Initiative, Bainbridge Basin; and
 - Ocean Survey Vessel Bold Summer 2008 Survey.
- 2010 and 2012 ENVVEST mussel data.
- 2005 and 2007 NOAA Mussel Watch at station SIWP.
- 2001 303d Ecology clam and crab sampling data.
- DU-2:
 - Sediment data collected during the 2010 TCRA and sediment data for PAHs collected during the 2008 TBA. These data met most of the MDAC criteria but have been superseded by DU-1 data collected in 2013, after the 2010 TCRA was completed.
- DU-R:
 - Soil and sediment data collected during the 1995 Ecology Field Inspection. These data had limited documentation, including poorly documented sampling locations, no documentation of collection or sample handling methods, and no chain of custody.
 - Groundwater data collected from temporary borings during the 2008 TBA. The samples were not filtered, and the data are not considered representative of groundwater conditions because of potential bias due to sample turbidity.

3.7 Existing Data Summary

This Section summarizes existing relevant data for soil, groundwater, and sediment. The data have been used to prepare the preliminary CSM (Section 4) to support the definition of the Initial Study Area (see Section 5.1) and to develop the scope of work for the RI. The existing data will be used in the RI to help assess the nature and extent of contamination. They include data from the 2007 Preliminary Upland Assessment, select data from the 2008 TBA, and data from the 2013 TCRA. Data classified as DU-1 (see Section 3.6) are included in the tables and figures associated with this Section. Data summary tables for each medium that include all data classified as DU-1 or DU-2 are provided in Appendix F.

3.7.1 NAPL Occurrences

Based on historical operations, LNAPL and/or DNAPL may be present at the Site. Gasoline and diesel petroleum products (LNAPLs) were transferred from docks via pipelines and stored in tank farms on the Former Gas Works Property and on three

adjacent bulk fuel storage properties. Light oil (LNAPL) was generated as a byproduct of manufactured gas production and was stored in the south central portion of the Former Gas Works Property. Tars (generally DNAPLs) generated as a byproduct of manufactured gas production were potentially generated at several locations along the gas production process (including the scrubbers, gas holder, and purifier) and were reportedly managed/stored/placed in several areas of the Site, including: the Former Ravine fill area; the tar wells and residue cistern, adjacent to the Former Ravine fill area; a drain pipe suspected to be the former outfall that was removed and plugged during the 2010 TCRA; and the former tar pit reportedly located in the southwestern corner of the Former Gas Works Property.

Previous field investigations have included observations of NAPL (e.g., product or oil droplets) or indicators of the potential presence of NAPL (e.g., heavy sheens or staining). NAPL has been observed at the Site in soil and sediments at several locations, as follows:

- In shallow intertidal sediment in the vicinity of the stormwater pipe outfall that was removed, plugged, and overlaid with an organoclay mat during the 2010 TCRA (see Section 3.3.1).
- In an area of shallow intertidal sediment north of the former gas works that was overlaid with an organoclay mat during the 2013 TCRA (see Section 3.3.2).
- At the following soil borings:
 - MW-3 at a depth of 5 feet (“dark staining, creosote-like/solvent odor”). This location is on the Former Gas Works Property in the vicinity of former tanks reportedly used to store tar.
 - MW-4 at a depth of 30 feet (“strong gas/diesel odor, product observed on grains¹³”). This location is on the Sesko Property downgradient of the former petroleum tank containment area.
 - MW-6 at a depth of 2 feet (“creosote-like odor and black tar-like substance”) and 15 feet (“sheen with dark black creosote-like staining”). This location is within the footprint of the former gas holder.
 - SP-03 at depths of 5 feet and 8 feet (“black coated sand...oil materials”), and 13.5 feet (“black coated sand...saturated with oil material”). This location is in the Former Ravine fill area adjacent to the former residue cistern and tar wells.

No NAPL samples have been collected or submitted for testing to characterize its chemical or physical properties. Sediments containing heavy sheens that were sampled during the 2010 and 2013 TCRAs exhibited higher concentrations of PAH compounds than surrounding sediment samples.

¹³ The exact same description of product noted at MW-4 was also noted at the same depth (30 feet) on the log for MW-6, but was in conflict with other field observations at the 30-foot depth interval at MW-6 (no sheen/slight sheen and low PID). Therefore, it is assumed that the note on MW-6 at 30 feet is an error.

Other potential indicators of NAPL presence include very high concentrations of organic compounds in soil (i.e., close to or above potential residual saturation levels) or in groundwater (e.g., greater than 10 percent of a component's aqueous solubility). Naphthalene has been detected in one well (MW-4, located in the Former Ravine fill area) at greater than 10 percent of its solubility.

3.7.2 Soil Data

Soil samples were collected as part of the investigations conducted in 2007, 2008, and 2013. These data sets include the following:

- **2007.** Seventeen soil samples were collected from eight explorations and analyzed for TPH, metals, SVOCs (including PAHs), VOCs and PCBs.
- **2008.** Forty-three soil samples were collected from eight explorations and analyzed for TPH, metals, SVOCs (including PAHs) and VOCs.
- **2013.** Two soil samples were collected from two explorations and analyzed for PAHs.

Table 3-10 summarizes the number of samples collected for analysis of each constituent and an evaluation of detected concentrations as compared to the initial PRG. Data for metals are also compared to the regional natural background concentrations established by Ecology (Ecology, 1994). The soil analytical data are summarized in tables provided in Appendix F.

The constituents detected in soil at concentrations above the initial PRGs include the following:

- VOCs, including 1,2,4-trimethylbenzene, benzene, and ethylbenzene;
- 2-methylnaphthalene;
- PAHs; and
- Metals, including antimony, arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, thallium, vanadium, and zinc.

Other than PAHs, no SVOCs were detected at concentrations above the initial PRGs except for a single detection of 2-methylnaphthalene; however, the reporting limits for a subset of SVOCs exceed the initial PRGs at some locations (Table 3-10 and Appendix F).

PCBs were not detected in soil; the reporting limits for PCBs in all samples were less than the initial PRGs (Appendix F).

Initial PRGs are not identified for TPH, which is not a hazardous substance under CERCLA. However, identifying the nature and extent of different TPH products (e.g., gasoline or diesel) may be helpful in defining contaminant sources. TPH data should be used with caution at sites, such as MGP sites, where non-petroleum hydrocarbon mixtures are present (e.g., carbureted water-gas tar). Therefore, an understanding of the type of product present, as assessed by sample chromatogram review or forensic analysis and interpretation, is needed to correctly interpret TPH data. For the purposes of this Work Plan, TPH distribution was not evaluated but will be evaluated in the RI.

A summary of VOCs, PAHs, and metals detected at concentrations above the initial PRGs is provided in the following Sections by analyte group. The maximum concentration

detected at each boring location and a comparison to the initial PRGs and/or natural background concentrations in shallow soil (0 to 10 feet deep) and deeper soil (greater than 10 feet deep) is provided for the primary constituents detected at concentrations greater than the initial PRGs¹⁴ (Figures 3-3 through 3-14). As described in Section 3.1.2, initial PRGs for surface soil include a consideration of potential terrestrial ecological exposure, whereas the initial PRGs for subsurface soil do not. For the purposes of presenting existing data in this Work Plan, soil data in the 0 to 10 feet in depth is compared to initial PRGs for surface soil to account for potential terrestrial ecological exposures.¹⁵

3.7.2.1 Volatile Organic Compounds

Two BTEX compounds, benzene and ethylbenzene, were detected at concentrations greater than the initial PRGs. The most frequent detections of benzene above the initial PRG occurred at two locations: in shallow soil collected at sample location MW-3, in the vicinity of the former finished gas storage tanks, and at sample location SP03, near the edge of the Former Ravine (Figure 3-3). Benzene was not detected in any deeper soil samples at a concentration above the initial PRG (Figure 3-4). BTEX compounds are potentially an indicator of MGP-related releases but may result from other sources (e.g., gasoline-range TPH or industrial solvents).

Concentrations of 1,2,4-trimethylbenzene were detected above the initial PRG in four soil samples. 1,2,4-trimethylbenzene is a component of carbureted water-gas tar and petroleum.

3.7.2.2 Polycyclic Aromatic Hydrocarbons

The maximum concentrations of naphthalene in shallow and deeper soil are shown on Figures 3-5 and 3-6, respectively. The concentrations of total carcinogenic PAHs (cPAHs)¹⁶ in shallow and deeper soil are shown on Figures 3-7 and 3-8, respectively. The vertical distribution of naphthalene concentrations in soil is illustrated along geologic cross sections A–A', B–B', C–C', and D–D' on Figures 2-9 through 2-12, respectively.

The concentrations of total cPAHs and naphthalene exceeding the initial PRGs were detected at sampling locations that correspond to operational areas of the former gas works. In shallow soil, the highest concentrations of both total cPAHs and naphthalene were detected at sample location MW-3, advanced in the vicinity of the storage tanks, which held light oil and carbureted water-gas tar (Simonson, 1997b). Likewise, the highest concentrations of both total cPAHs and naphthalene in deeper soil were detected at sample location MW-6, which was advanced at the location of the former gas holder.

Generally, concentrations of naphthalene and cPAHs on the Former Gas Works Property are highest in shallow soil and decrease with depth (MW-3 and SP03, for example).

¹⁴ Primary constituents shown on the figures include those detected in excess of the PRGs and the natural background concentrations with the greatest frequency or magnitude.

¹⁵ As noted in Section 4.3, 'surface soil' for the purposes of the ecological and human health risk assessments may vary depending on the applicable exposure pathway but is generally 3 feet or less in depth. However, there is limited existing data in this interval; therefore, separate figures for surface soil were not prepared for this Work Plan.

¹⁶ Concentrations of total cPAHs are provided in benzo(a)pyrene toxic equivalent concentrations (EPA, 1993).

However, at MW-6, advanced at the location of the former gas holder, PAH concentrations detected in deeper soil were much higher than those in shallow soil. Because the gas holder was reportedly at least 10 feet deep, this finding may indicate that the gas holder was filled with cleaner soil after it was demolished. Also, the concentrations of PAHs detected in deeper soil were greater than those in shallow soil at well MW-8, located hydraulically downgradient of the former gas works operational area.

The concentrations of total cPAHs exceeding the initial PRG have been detected in soil samples collected between depths of 3 and 40 feet. The highest concentrations of total cPAHs were detected in shallow soil, between the depths of 5 and 12 feet, at well MW-3, well MW-6, and boring SP03 and in deeper soil at a depth of 25 feet at well MW-8.

The presence of cPAHs and naphthalenes is a potential indicator of MGP-related releases.¹⁷

3.7.2.3 Metals

The detectable concentrations or analytical reporting limits for a number of metals exceeded the initial PRGs. However, the concentrations of many of these metals did not exceed the natural background concentrations¹⁸ (Ecology, 1994):

- For manganese and antimony, all of the detected concentrations, and most of the reporting limits, are below the background concentrations.¹⁹
- Cobalt and vanadium were detected in all of the soil samples analyzed for metals, with many concentrations exceeding the initial PRGs; however, the detected concentrations are generally within the range of regional background concentrations.
- Thallium was detected at concentrations above the initial PRGs in most of the soil samples analyzed; a natural background concentration for thallium was not available.

Detected concentrations of cadmium, lead, and zinc are within the range of regional background concentrations at most sample locations, except for borings MW-5, MW-8, and SP03, which are located at the northeast corner of the Former Gas Works Property in the shoreline and Former Ravine fill area.

Arsenic, chromium, copper, and nickel were detected at concentrations above the initial PRGs and background concentrations at several locations. Figures 3-9 through 3-14 depict the concentrations of arsenic, copper, and nickel²⁰ in shallow and deeper soil. Concentrations of these metals in deeper soil do not exceed the initial PRGs, with the exception of arsenic, which was detected at a concentration above the initial PRG but below the natural background concentration. Concentrations of arsenic, copper, and nickel in shallow soil exceed the initial PRGs and the natural background concentrations at

¹⁷ Carcinogenic PAHs and naphthalenes can also originate from other sources, including petroleum hydrocarbons or creosote. Forensic analyses, such as PAH fingerprinting, may be useful during the RI to help distinguish and identify potential sources of contamination.

¹⁸ Puget Sound background concentrations of metals were used for screening when available. When not available, Washington State background concentrations were used.

¹⁹ The Puget Sound regional background concentration for antimony has not been researched. The referenced background concentration is based on regional data from the Spokane Basin.

²⁰ Arsenic, copper, and nickel were mapped in soil because these constituents were also most frequently detected in groundwater at concentrations greater than the surface water or groundwater initial PRGs.

several locations. Arsenic was detected at concentrations above the natural background concentration at two locations: SP03 (Former Ravine fill area) and MW-3 (within the footprint of former gas works operations and the current industrial park). Copper, chromium, and nickel were sporadically detected across the Former Gas Works Property at concentrations above the natural background concentrations, but their maximum concentrations were only slightly above their respective background concentrations (62.7 milligrams per kilogram [mg/kg] versus 38 mg/kg for copper; 60.8 mg/kg versus 48 mg/kg for chromium; and 60.9 mg/kg versus 48 mg/kg for nickel). The sources of these exceedances are unclear from the existing data. Possible sources include contaminated fill, historical industrial operations, or natural background variability.

3.7.3 Groundwater Data

Groundwater samples were collected as part of the investigations conducted in 2007 and 2008. Groundwater samples were collected and analyzed for petroleum hydrocarbons, metals, SVOCs including PAHs, VOCs, and PCBs. Table 3-11 summarizes the number of samples collected for analysis of each constituent and the results of a comparison of detected concentrations to the initial PRGs, which include concentrations protective of groundwater and surface water. The groundwater analytical data are provided in Appendix F.

The constituents detected in groundwater at concentrations greater than the initial PRGs include the following:

- Metals: arsenic, beryllium, chromium (both total and hexavalent), cobalt, copper, lead, manganese, mercury, nickel, thallium, vanadium, and zinc;
- PAHs: acenaphthene, benzo(g,h,i)perylene, dibenzofuran, fluoranthene, florene, phenanthrene, pyrene, naphthalenes, and total cPAHs;
- Pentachlorophenol (PCP); and
- VOCs: benzene, ethylbenzene, xylenes, 1,2,4- and 1,3,5-trimethylbenzene, 1,2-dichloroethane, carbon tetrachloride, chloroform, isopropylbenzene, n-hexane, and trichloroethene.

Other than the above-listed constituents, no SVOCs or VOCs were detected at concentrations above the initial PRGs; however, the reporting limits for a subset of SVOCs and VOCs exceed the initial PRGs at a number of locations (Table 3-11 and Appendix F). PCBs were not detected in groundwater; however, the reporting limits for PCBs in all samples were above the groundwater initial PRG (Appendix F).

The existing groundwater data are limited, with one sampling event at 10 locations and no groundwater data collected since 2008. The data are useful for the preliminary identification of COPCs, and they indicate where groundwater impacts may be located. Some of the existing data were collected from wells that are still in place. These wells can likely be used for future monitoring, and the comprehensive data set will likely be useful in evaluating long-term trends in groundwater quality.

VOCs, PAHs, PCP, and metals detected at concentrations above the initial PRGs are discussed in the following Sections by analyte group. The concentration detected at each monitoring well and a comparison to the groundwater initial PRGs are provided for the

primary constituents detected at concentrations above the initial PRGs²¹ on Figures 3-15 through 3-19.

3.7.3.1 Volatile Organic Compounds

One or more of the BTEX compounds were detected in groundwater samples collected at all of the monitoring wells, except for wells MW-1 and SP02. The detected concentrations of benzene in groundwater are shown on Figure 3-15. The highest concentrations were detected in wells MW-3, MW-6, and MW-8 (in and downgradient of the former gas works operation area).

3.7.3.2 Polycyclic Aromatic Hydrocarbons

Detected concentrations of total cPAHs were above the initial PRGs in groundwater samples collected from wells MW-3 through MW-8 (Figure 3-16) located on the Former Gas Works Property. The highest concentration of total cPAHs in groundwater was detected at well MW-4. There were no detected concentrations of cPAHs in the groundwater samples collected from wells MP04, SP02, MW-1, and MW-2.

The results for other PAHs are the following:

- Dibenzofuran and pyrene were detected at concentrations above the initial PRGs in the groundwater sample collected from well MW-4; and
- Naphthalenes, including 1-methylnaphthalene and naphthalene, were detected in groundwater samples collected from wells SP02, MP04, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8 at concentrations exceeding the initial PRGs. The highest concentrations of naphthalene were detected at wells MW-4 and MW-8 (Figure 3-17).

3.7.3.3 Pentachlorophenol

PCP was detected in groundwater at a concentration exceeding the groundwater and surface water initial PRGs at well MW-8.

3.7.3.4 Metals

The highest concentrations of metals in groundwater were generally detected at wells MW-3 and MW-4. MW-3 is located in the central portion of the Former Gas Works Property, in the vicinity of the former finished gas storage tanks and former metal finishing operations. MW-4 is located within the Former Ravine fill area, in the central portion of the Sesko Property. Results for specific metals are the following:

- Arsenic was detected in all of the groundwater samples analyzed, at concentrations ranging from 0.6 to 26 micrograms per liter (µg/L), all of which exceed both the groundwater initial PRG and the surface water initial PRG. Figure 3-18 depicts the concentrations of arsenic in groundwater, which are highest in the central portion of the Former Gas Works Property, at wells MW-3 and MW-4
- Hexavalent chromium was detected in groundwater samples collected from wells MW-1 and MW-3 through MW-8 at concentrations exceeding the groundwater initial

²¹ Primary constituents shown on the figures include those detected with the greatest frequency or magnitude above the groundwater initial PRG.

PRG. The concentrations detected in wells MW-5 and MW-8 also exceed the surface water initial PRG. Figure 3-19 depicts the concentrations of hexavalent chromium in groundwater.

- Total chromium and lead were detected in groundwater at concentrations above both the groundwater initial PRGs and the surface water initial PRGs in the samples collected from wells MW-3 and MW-4.
- Copper and nickel were detected at concentrations exceeding the surface water initial PRGs at most of the sampling locations; none of the concentrations of copper and nickel exceeds the groundwater initial PRGs. The highest concentrations of copper and nickel were detected in groundwater samples collected from wells MW-3 and MW-4.
- Concentrations of cobalt, manganese, thallium, and vanadium exceeding the groundwater initial PRGs were detected in the groundwater sample collected from well MP04.

3.7.4 Sediment Data

Available sediment data for the Site include those collected in 2008 as part of the TBA, in 2010 as part of the 2010 TCRA, and in 2013 as part of the 2013 TCRA. These data sets include the following:

- **2008.** Five surface sediment samples from the beach north of the Former Gas Works Property were analyzed for TPH, VOCs, SVOCs, and metals.
- **2010.** Thirty-two surface sediment samples collected during the 2010 TCRA were analyzed for VOC and SVOCs.
- **2013.** Thirty-nine surface sediment samples collected during the intertidal sediment sampling program were analyzed for total solids (TS), total organic carbon (TOC), and SVOCs.
- **2013.** Seventeen subsurface sediment samples were collected by direct-push methodology at seven locations (boring depths ranged from 4- to 5-feet below the sediment surface). Samples from 4 discrete intervals were analyzed for VOCs, and samples from 17 subsurface intervals were analyzed for TS, TOC, and SVOCs.

Table 3-12 presents these sediment data and concentrations relative to the initial PRGs identified in Section 3.1.2. Where applicable, reference values are also presented for natural background concentrations of contaminants in Puget Sound sediments or soils.

Figures 3-20 through 3-24 present the measured concentrations of PAHs in beach sediments at the Site. Data are presented on a dry-weight basis for benzo(a)pyrene, total low-molecular-weight PAHs (LPAHs), total high-molecular-weight PAHs (HPAHs), total cPAHs, and total cPAH toxic equivalent (TEQ) concentrations. The highest PAH concentrations were detected within and near the two removal action areas. East and west of these two areas, concentrations decrease rapidly.

3.8 Existing Data from Other Cleanup Sites

Soil and groundwater data collected on the Former SC Fuels Property include TPH, BTEX, and lead (Section 3.4). The majority of the soil data were collected prior to and during remedial actions (removal of USTs and surrounding contaminated soil), which

occurred in 2002. The most recent groundwater monitoring data are from January 2007. During that sampling event, concentrations of benzene were detected in groundwater at concentrations up to 88 µg/L on the Former SC Fuels Property and up to 49 µg/L in the eastern portion of the Pennsylvania Avenue right-of-way (GeoScience Management, 2007). The extent of benzene detected in groundwater (detection limit 1 µg/L) in 2007 is shown on Figure 3-25.

3.9 Data for Port Washington Narrows, Sinclair Inlet and Dyes Inlet

A number of high-quality sediment and tissue studies were identified for the Port Washington Narrows, Sinclair Inlet, and Dyes Inlet. The locations where sediment and tissue data with measured PAH concentrations were collected are shown on Figure 3-26. These data will not be used for data screening or COPC identification (see Section 4.4), but may provide useful information about conditions in the vicinity of the Site.

Because the delineation between the Site's contamination and other sources of contamination is not straightforward, these data were thought to be potentially useful to assess whether off-Site sediment quality could potentially affect conditions at the Site through sediment transport and recontamination processes. After review of these data, it was determined that additional sampling and assessment would be required to understand sediment transport into and out of the Site for the purposes of the FS. The approach being used to assess sediment transport mechanisms in the vicinity of the Site is described in Section 5.5.2.

No recently-collected water quality data for chemical contaminants within the Port Washington Narrows have been identified. Several studies have been conducted to assess potential contaminant inputs to Dyes Inlet and adjacent waters (Crecelius et al., 2003). The results of these and other available studies may be used qualitatively for evaluating the potential influence of nonpoint sources of pollution on the Site, but will not be relied upon for the baseline risk assessment.

4 Preliminary Conceptual Site Model

This Section presents the preliminary CSM, which has been developed based on available historical information, the current understanding of the environmental setting, and the findings of previous investigations, as presented in Sections 2 and 3. The CSM is a description of environmental conditions that includes sources of contamination, contaminant fate and transport in Site media, and potential routes of contaminant exposure for human and environmental receptors. A three-dimensional graphical CSM illustrating representative potential historical sources and migration of contaminants at the Site is provided on Figure 4-1, and a conceptual CSM cross section is shown on Figure 4-2. The CSM will be developed further during the RI and risk assessment as more Site-related information and data are gathered.

4.1 Potential Sources of Contamination

This Section summarizes potential sources of contamination on the Former Gas Works Property and on surrounding properties. The potential sources and locations associated with known and documented operations (both MGP and other) are presented in the following Sections; however, this discussion does not include undocumented or currently unknown potential sources or source areas, which may be identified through the collection and evaluation of data during the RI.

4.1.1 Former Gas Works Property Sources

Potential sources of contamination on the Former Gas Works Property include historical activities associated with the former gas works, as well as other activities on the property that are unrelated to gas works operations.

4.1.1.1 Sources Related to Gas Works Operations

The potential primary sources associated with the production of manufactured gas are depicted on Figure 2-3. The area in which the gas production process occurred is divided into potential source areas based on the predominant use and subsequent primary potential release mechanisms associated with each area. The primary potential source areas include the following:

- **Coal/Coke Briquettes Area.** As described in Section 2, solid feedstocks (coal and coke briquettes) were transported to the Former Gas Works Property by barge and offloaded and transported over the water, beach, and bluff to a concrete surface storage area in the northwest corner of the Former Gas Works Property. Coke briquettes have been observed on the beach and bluff, suggesting spills during the transport process. Additionally, coal/coke dust may have been swept off the concrete storage slab onto the surrounding ground surface.
- **Tar and Petroleum Transfer Area.** Petroleum products were delivered to the Former Gas Works Property and tar was removed from the Former Gas Works Property by barge. Petroleum and tar from pipelines along the dock and at the connection to the barges may have been released directly to sediment or surface water. A pipeline

presumably ran between the dock and the byproduct storage area to transport tar to the dock, but the location is unknown.

- **Petroleum Storage Area.** Petroleum products were stored in ASTs in the northeastern portion of the Former Gas Works Property. The products reported to have been stored in these tanks include gasoline and diesel fuel oil. Transfer piping presumably ran from the storage tanks to the furnaces, but the exact location of transfer piping is unknown. Petroleum may have been released from tanks and piping to soil at the ground surface or shallow soil in this area.
- **Gas Generation and Purification Area.** The main process area was located in the central portion of the Former Gas Works Property and included the furnaces, scrubber, gas holder, and purifier. The primary potential sources associated with the gas works process consist of spills, drips, and leaks of spent liquids, oils, gas liquor, tar, and tar-water mixtures from aboveground equipment, piping, and storage tanks to the ground surface.
- **Residuals Management Area.** A map of the former plant shows tar wells and a residue cistern to the east of the purifiers. These were likely used for separation of tar-water emulsions prior to resale of the tar. The details of the tar wells and residue cistern are unknown, but they likely extended into shallow subsurface soil and may have either been lined or unlined at the base. A second area south of the main plant building was reportedly used for storage and/or separation of tar and tar-water emulsions in a tar pit. Oils and tar may have been released to the ground surface around these features or the shallow soil beneath them.
- **Tar and Light Oil Storage Area.** The southern portion of the Former Gas Works Property was used for the storage of tar and light oil in ASTs. Tar and light oil may have leaked or been spilled onto the ground surface in the vicinity of the ASTs. Finished gas may have contained small amounts of oil that condensed in the distribution piping and were collected in the drip tank. Light oil may have been released to shallow soil in the vicinity of the pipes and tank.
- **Former Drainage Line Area.** During the 2010 TCRA, a former drainage line on the Sesko Property that discharged to the Port Washington Narrows was identified. Tar-like hydrocarbons were identified in this drainage line, which was plugged during the 2010 TCRA (see Section 3.3.1). The alignment of the drainage line is similar to the alignment of a former City CSO outfall documented in historical records. Wastewater and associated contaminants may have discharged from this drainage line during and after operation of the former gas works.
- **Ravine and Shoreline Fill Areas.** Historical documents indicate gas works byproducts may have been placed into the western portion of the Former Ravine, to the east of the gas generation and purification area, and along the bluff to the north of the gas generation and purification area for some period of time. Materials that were reportedly placed along the shoreline include ash, cinders, slag, and soot. Materials that were reportedly placed in the Former Ravine include ash, cinders, slag, soot, spent scrubber media (tar-laden wood chips and shavings), and spent purifier filter media (wood chips and/or iron oxide). The approximate areas where gas works byproducts may have been placed are shown on Figure 2-3.

4.1.1.2 Sources Related to Other Operations on Former Gas Work Property

Other potential primary sources are associated with activities conducted after the shutdown and demolition of the former gas works, or they were conducted in the immediate vicinity of the former gas works. These sources are shown on Figure 2-4 and summarized as follows:

- **Bulk Petroleum Storage.** Petroleum products were delivered to Lent's at a dock offshore of the Sesko Property and stored in ASTs for distribution by fuel delivery vehicles. Petroleum may have been released from piping and storage tanks to the ground surface and/or shallow soil.
- **Varied Light Industrial Use.** Since the shutdown of the former gas works, the McConkey Property has been used for miscellaneous light industrial activities, including vehicle parking, metals fabrication, and equipment storage. Ecology inspections in 1992, 1993, and 1994 indicated poor housekeeping practices associated with some of these operations. These operations are potential sources of solvents, metals, and petroleum hydrocarbons, which may have been released to the ground surface as either solids (sandblast grit, paint sludges, etc.) or components of liquids.
- **Equipment Storage and Repair and Debris Filling.** In addition to the bulk petroleum storage described above, activities on the Sesko Property since the shutdown of the former gas works included boat maintenance and storage, automobile salvage, and equipment and debris storage including storage of derelict vessels and miscellaneous equipment, such as the float tanks that are still present on the beach.²². These activities may be sources of contaminants to soil, sediment, and surface water by direct discharge, dumping, or spills to the ground surface.
- **Other Operations.** Other operations have reportedly included filling of the Former Ravine and shoreline areas, particularly on the Sesko Property. These operations may have included disposal of incinerator refuse, garbage, and ashes; placement of concrete and piping debris; and/or placement of miscellaneous metal, concrete, and fiberglass debris associated with maintenance and salvage of boats and equipment. Fill placed along the shoreline and in the Former Ravine may have included materials that contained hazardous substances. Although the presence of fill material alone does not necessarily represent a contaminant source, hazardous substances may subsequently migrate to surrounding sediment, soil or groundwater.

4.1.1.3 Stormwater Discharge

Stormwater discharging to the Port Washington Narrows may contain contaminants and is a potential source of contamination to sediments or surface water. The outfalls that historically have captured or currently capture water at the Former Gas Works Property are the following:

²² The float tanks are believed to be submarine floatation tanks and are not known to have been used to store hazardous substances. They are no longer watertight and DNR has ordered the owner of the Sesko Property to remove the tanks from state-owned aquatic land. The timeline for removal is unknown. The investigation work described in this Work Plan includes sampling near the float tanks. The presence of the tanks does not impede investigation activities planned at this time.

- **Historical City Stormwater/CSO Outfall.** As noted in Section 4.1.1.1 (list item “Former Drainage Line Area”), a historical drainage line and outfall were located within and offshore of the Sesko Property. A section of the drainage line on the beach was reportedly removed by the City during installation of a force main in the 1990s. The drainage line was plugged and partially removed as part of the 2010 TCRA (see Section 3.3.1). An upland manhole and storm drainage lines believed to be connected historically to the drainage line were plugged as part of the 2013 TCRA.
- **McConkey Drainage Line.** A small drainage line discharges stormwater from a shallow catch basin on the McConkey Property to the Port Washington Narrows.

4.1.2 Sources Related to Operations on Adjacent Properties

Potential primary sources on adjacent properties include the following:

- **Bulk Petroleum Storage.** Petroleum products were delivered by barge to bulk fuel storage facilities at the Former ARCO Dock, the Former Sesko Dock, and the former SC Fuels Dock and stored in ASTs or USTs for distribution by fuel delivery vehicles. These petroleum storage facilities were located on the Former ARCO Property located west of the former gas works and the Former SC Fuels Property. Petroleum may have been released from piping and storage tanks to the ground surface and/or shallow soil while these operations were ongoing.
- **Varied Light Industrial Use.** The Penn Plaza Property has been used for miscellaneous light industrial activities, including spray painting, a pipe shop, vehicle parking for a petroleum distributor, truck repair electroplating, metals fabrication, and equipment storage. Ecology inspections in 1992, 1993, and 1994 indicated poor housekeeping practices associated with some of these activities. These activities are potential sources of solvents, metals, and petroleum hydrocarbons, which may have been released to the ground surface as either solids (sandblast grit, paint sludges, etc.) or components of liquids.

4.1.2.1 Stormwater Discharge

A number of documented stormwater and CSO outfalls are located within the Port Washington Narrows and Dyes Inlet (Section 2.7), including the two outfalls described in Section 4.1.1.3. Other nearby outfalls or discharge lines include the following:

- **Current City Stormwater/CSO Outfall.** An active City stormwater/CSO outfall is located along the Port Washington Narrows, offshore of the end of Pennsylvania Avenue. This outfall is located adjacent to the 2010 TCRA area (Figure 3-2).
- **Drain Line.** A drain line from an oil-water separator on the Former SC Fuels Property discharges to the Port Washington Narrows.

4.2 Contaminant Migration and Transformation

Contaminants derived from the sources described in Section 4.1 may have been released to soil (surface and shallow subsurface), sediment, and/or surface water. Representative potential releases (e.g., leaks or spills from equipment, tanks, or piping; placement of contaminated fill materials; and discharges from outfalls) are shown conceptually on Figures 4-1 and 4-2. The released contaminants may have migrated from one location to

another or from one medium to another. Contaminants may also undergo attenuation or transformation processes within media. The contaminant migration pathways and transformation processes are described in the following Sections.

4.2.1 Migration Pathways

Examples of potential contaminant migration pathways between media are shown conceptually on Figures 4-3, 4-4, and 4-5, and include the following:

- Migration of contaminants from surface soil to subsurface soil (e.g., leaching or product migration);
- Contaminant leaching or NAPL migration from soil/NAPL to groundwater;
- Groundwater/NAPL transport within the saturated zone;
- Groundwater discharges to surface water;
- Contaminant partitioning between groundwater and sediments (including sediment porewater);
- Migration of volatile NAPL/soil/groundwater contaminants to air;
- Migration of surface soil contaminants as fugitive dust;
- Release of surface soil contaminants to stormwater;
- Uptake of contaminants by terrestrial or aquatic biota; and
- Migration of contaminated sediments by sediment transport.

Based on the data collected to date (see Section 3.7), contaminants have been identified in soil, groundwater, and sediment. No Site-specific surface water, air, or tissue data are available. Contaminant occurrences in these media may be due to direct releases or subsequent migration, for instance:

- Soil contamination may be the result of contaminated fill materials, downward flows of NAPL releases²³ through the subsurface and the coating of soil grains, or sorption of contaminants from other media (e.g., soil vapor, infiltrating stormwater, or groundwater).
- Groundwater contamination may be the result of direct discharge of contaminated aqueous materials and their migration downward through the subsurface and mixing with groundwater, leaching of NAPL in contact with groundwater, or stormwater infiltration of the subsurface, leaching of contaminants from NAPL or contaminated soil, and contaminant mixing with groundwater.
- Contaminants in sediment may be the result of direct releases to surface sediments (e.g., documented discharges from outfalls, undocumented spills, or leaks from dock piping and transfer operations); subsurface migration of contaminated groundwater or NAPL from the uplands, and migration through sediments; or a combination of

²³ Liquid releases generally move downward, through the subsurface by means of gravity, but they may move laterally by preferential migration pathways if a barrier (e.g., low-permeability soils or, for NAPLs that are less dense than water, groundwater) is encountered.

sources. In particular, two sediment “hot-spot” areas were addressed by the 2010 and 2013 TCRA:

- The 2010 TCRA addressed a drain pipe that contained residual NAPL and surrounding contaminated sediments, which appeared to be the primary source of contamination in this area. The historical and ongoing contribution to sediment contamination from other potential sources in this area, including groundwater discharge, stormwater runoff, and the City CSO, is unknown.
- The 2013 TCRA addressed an area of heavy sheen located in shallow subsurface sediments and solid surficial material containing high PAH concentrations. It is likely that the solid surficial material, which would be immobile in the subsurface, was placed at or near its locations; however, the source of the material is unknown. The source of the subsurface sheen is also unknown. During the TCRA investigation, a sheen was observed up to the base of the bluff. However, there are insufficient data to determine whether this contamination is contiguous with contamination in the upland.

Representative migration pathways, including subsurface migration pathways, are indicated on Figures 4-1 and 4-2.

4.2.2 Transformation Processes

In addition to contaminant migration pathways, contaminant concentrations in media can be reduced or attenuated by various combinations of natural processes. Examples of such processes include the following:

- Chemical or biological degradation of contaminants in soils, groundwater, sediments;
- Tidally induced mixing of groundwater near the groundwater/surface water interface;
- Natural recovery of marine sediments by burial, mixing, and/or degradation processes; and
- Metabolic transformation or elimination of chemical contaminants from the tissues of upland or aquatic biota.

4.3 Exposure Pathways and Receptors

Exposure pathways are the routes through which people or ecological organisms are exposed to chemicals (e.g., through eating, drinking, breathing, touching). Relevant and representative human and ecological receptors that may use the Site are summarized in Figures 4-3, 4-4, and 4-5. These figures illustrate how humans and ecological receptors may be exposed to chemicals. To determine whether an exposure pathway is complete and, therefore, exposure can occur, the following four elements must be evaluated:

- Source of chemical release;
- Release or transport mechanism (or media in cases involving media transfer);
- Exposure point (a point of potential human or ecological contact with the contaminated exposure medium); and

- Exposure route (e.g., ingestion or dermal contact) at the exposure point.

If any of these elements are missing, the pathway is considered incomplete and exposure will not occur. The definitions of all possible exposure pathway designations are as follows:

- Preliminary Complete Exposure Pathway – There is a source, a release and transport mechanism from a source, an exposure point where contact can occur, and an exposure route through which contact can occur. These complete exposure pathways will be quantitatively evaluated in the risk assessment.
- Preliminary Complete Exposure Pathway, Low Exposure Potential – There is a source, a release and transport mechanism from a source, an exposure point where contact can occur, and a limited exposure route through which contact can occur. These complete exposure pathways will be quantitatively evaluated in the risk assessment.
- Currently Incomplete Exposure Pathway, Potential Future Exposure Evaluation – There is a source, a release and transport mechanism from a source, an exposure point where contact can occur, and a currently incomplete exposure route through which contact can occur. If future conditions change, the exposure would be complete. These exposure pathways will be quantitatively evaluated in the risk assessment.
- Preliminary Incomplete Exposure Pathway – There is either no source, no release or transport mechanism from a source, no exposure point where contact can occur, and/or no exposure route through which contact can occur for the given receptor. Pathways considered incomplete will not be evaluated further in the risk assessment.

Figure 4-3 illustrates different exposure pathways that could affect people using the Site or nearby areas. The potential exposure of people to Site-related COCs differs in terms of both how those people use the Site and which areas of the Site are used. (i.e., beach/aquatic areas and upland areas). Some land uses could also change over time. For example, the Site is not zoned for residential land use, but as part of the risk assessment activities, it may be prudent to evaluate potential future residential land use to understand the implications of changes in land use or zoning. Similarly, shellfish harvesting in the Port Washington Narrows is restricted due to shellfish harvesting closures unassociated with the former gas works. However, it may be prudent to evaluate potential future shellfish harvesting to understand potential exposures should those shellfish harvesting restrictions be lifted.

Preliminary complete current and future human exposure pathways to contaminated media include dermal contact with and incidental ingestion of soil or sediment, dermal contact with groundwater, inhalation of fugitive dust and vapors, and consumption of fish/shellfish that are potentially contaminated with bioavailable Site-related contaminants. Preliminary incomplete current and future human exposure pathways will be evaluated further as part of the RI and risk assessment (see Section 6 for planned RI and risk assessment methodology). The preliminary human exposure scenarios relevant to the Site include the following:

- Human Use of Beach/Aquatic Site Areas:

- Recreational Beach Users. There is a potential for limited recreational beach use by individuals residing near the Site. During recreational use of the beach, these individuals could be exposed through dermal contact and incidental ingestion of sediment and porewater.
- Tribal Subsistence and Recreational Consumers of Fish/Crab from the Port Washington Narrows. The portions of the Port Washington Narrows adjacent to the Former Gas Works Property currently support the collection and consumption of fish and crabs under WDFW regulations. The Port Washington Narrows is also a Usual and Accustomed area of the Tribe. Consumers of fish and crabs may be exposed to Site-related COCs through direct contact with and incidental ingestion of sediment and porewater during harvesting activities, and through ingestion of fish/crab tissue.
- Tribal Subsistence and Recreational Consumers of Shellfish at the Site (currently restricted by Shellfish Harvesting Closures). The portions of the Port Washington Narrows adjacent to the Former Gas Works Property are currently closed to shellfish harvesting by WDOH (due to water quality concerns associated with CSOs and other non-Site-related concerns); however, exposures associated with shellfish harvesting will be evaluated to understand potential future risks should the shellfish harvest restrictions be lifted. Future consumers of shellfish may be exposed to Site-related COCs through ingestion of shellfish tissue and dermal contact with and incidental ingestion of sediment and porewater during harvesting activities.
- Beach Construction/Excavation Workers. This scenario relates to workers performing utility upgrades or maintenance or other activities that involve the disturbance of sediment in the beach area adjacent to the Former Gas Works Property. Beach construction workers could be exposed to Site-related COCs through direct contact with porewater and through direct contact with and incidental ingestion of surface and subsurface beach sediment.
- Human Use of Upland Site Areas:
 - Occupational Workers. The Former Gas Works Property and the properties in the vicinity are zoned for industrial uses. Occupational workers at the Site could be exposed to Site-related COCs through direct contact with and incidental ingestion of surface soil and inhalation of vapors while working in the upland portion of the Site. The occupational worker scenario assumes that workers do not frequent the beach portion of the Site during typical work activities.
 - Upland Construction/Excavation Workers. This scenario relates to workers performing utility upgrades or maintenance or other activities that involve the disturbance of soil at the Former Gas Works Property and the properties in the vicinity. Upland construction workers could be exposed to Site-related COCs through dermal contact with and incidental ingestion of soils and inhalation of vapors. Typical construction worker activities

(e.g., grading or excavation for building foundations) are expected to extend up to approximately 3 feet in depth.²⁴

- Potential Future Residential Users of the Site (Not a Current or Planned Use). The Former Gas Works Property and the properties in the vicinity are zoned for industrial uses, and this is expected to remain the case for the foreseeable future. However, the potential for exposures of future residents may be appropriate to evaluate as part of the risk assessment to understand potential implications should properties within the Site be converted to residential uses. On-site residents could be exposed to Site-related COCs through direct contact with and incidental ingestion of surface soils and inhalation of vapors. No water supply wells are located on or near the Former Gas Works Property, but consumption of groundwater has been retained as a potential pathway for screening, pending further evaluation of groundwater beneficial uses.

The Site and vicinity are used by a variety of upland and aquatic species. An initial list of species common to the region has been compiled (Table 4-1), using locally available published sources. Listed in the table are species that use or may occasionally use the Site and vicinity. The species listed in Table 4-1 are grouped into representative categories to illustrate different ecological exposure pathways.

Preliminary representative receptors that could potentially use the Site and be directly or indirectly exposed to contaminated media were identified from the list of species common to the region (Table 4-1). EPA guidance is available to help identify receptors potentially at risk (EPA, 1992, 1997a, and 1998b). Receptors potentially at risk include:

- Federal or state rare, threatened, or endangered species
- Resident species or communities with the greatest exposure to chemicals in sediment and surface water
- Species or functional groups that are essential to, or indicative of, the normal functioning of the affected habitat

Based on review of the USFWS catalogue of federally listed species that could potentially be within the Site vicinity (2016), the following five species are listed:

- Bull trout (*Salvelinus confluentus*)
- Killer whale (*Orcinus orca*)
- Marbled murrelet (*Brachyramphus marmoratus*)
- Streaked horned lark (*Eremophila alpestris strigata*)
- Yellow-billed cuckoo (*Coccyzus americanus*)

²⁴ For the purposes of the RI, “surface soil” is defined as the 0- to 3-foot interval, based on likely ecological and human health exposure scenarios.

WDFW also identifies species with a State endangered, threatened, sensitive, candidate or monitored status (WDFW, 2016). Regionally common species with a Federal or Washington State listing are identified in Table 4-1.

At the Site, the ecological receptors potentially at risk include the animals and plants that use the terrestrial and/or aquatic habitats within the Site. These were categorized into plant, invertebrate, reptile and amphibian, fish and shellfish, and bird and mammal groups. Species within these groups likely to be present at the Site were determined through review of relevant regional information. The representative species from these groups were selected as target species to be evaluated in the risk assessment. A brief description of each group is as follows.

Plants. Both terrestrial and aquatic plants are important resources because they provide significant habitat for fish and wildlife. Terrestrial vegetation is limited in the Site and primarily exists along the bluff. The riparian zone is primarily forested riparian and is generally present across the Site shoreline. Aquatic vegetation in Dyes Inlet is patchy. Dyes Inlet and Sinclair Inlet do not support any floating kelp and non-floating kelp species are present in just 18% of the shoreline throughout the entire basin (Redman et al, 2005).

Invertebrates. The invertebrate community (both terrestrial and aquatic) is an important receptor group because soil and benthic invertebrates consume plants and detritus, provide critical nutrient cycling, and represent a trophic link to other organisms that consume them. Because invertebrates, with the exception of crabs, are relatively sessile and are in direct contact with soil or sediment, they provide an integrated measure of toxicity. Benthic organisms observed in the intertidal and nearshore of Sinclair inlet include crustaceans, molluscs, arthropods, polychaetes and echinoderms (GeoEngineers, 2011; KiTSA, 2012).

Reptiles and Amphibians. Reptiles potentially using the Site include common garter snakes (*Thamnophis* spp.). Frogs, turtles, salamander and newts inhabit the Sinclair Inlet Watershed (KiTSA, 2012), but are not likely to be present at the Site due to unsuitable habitat. Reptiles and amphibians will not be directly assessed in the ERA because exposure models and toxicological data for reptiles and amphibians are limited. There is significant uncertainty associated with the exposure and sensitivity of this group of receptors to COPCs at the Site. Given the limited information available, a meaningful assessment of risk to this group of receptors is not possible. However, it is assumed that the risk characterization and risk-based management for other assessment endpoints (e.g., soil invertebrates, mammals, fish, and birds) will provide protection of reptiles and amphibians at the Site.

Fish and Shellfish. Fish and shellfish are key elements of freshwater, estuarine, and marine ecosystems for a number of reasons. As one of the most diverse groups of vertebrates, fish are able to occupy a wide range of ecological niches and habitats. As such, fish represent important components of aquatic food webs by processing energy from aquatic plants (i.e., primary producers), zooplankton and benthic macroinvertebrate species (i.e., primary consumers), or detritivores. Fish also represent important prey species for piscivorous wildlife including reptiles, birds, and mammals. Fish species present in Sinclair and Dyes Inlets includes representatives of the benthivorous, omnivorous and piscivorous guilds. Common species are summarized in Table 4-1.

Birds. Birds likely to be found at the Site are grouped as primarily marine-dependent or terrestrial-predators. The primary terrestrial avian feeding guild at the Site is avian predators which includes robins and crows. Aquatic-dependent species guilds include piscivorous raptors and other shorebirds. Species common to Sinclair and Dyes Inlets include great blue heron, osprey (KiTSA, 2012), and sediment-probing birds such as the sandpiper (Buchanan, 2006).

Mammals. Mammals common to the region and likely to be present at the Site include occasional coyotes, rabbits, squirrels, voles, shrews, mice, moles, and raccoons (KiTSA, 2012). Mammals will be grouped into terrestrial and aquatic-dependent receptors for the ERA. Primary terrestrial mammal feeding guilds include herbivorous mammals, insectivorous mammals, omnivorous mammals, and carnivorous mammals. Aquatic-dependent mammals common to the region and likely to be present at the Site for extended periods of time comprise members of the piscivorous feeding guild including Dall's porpoise, harbor porpoise, California sea lion, harbor seal, northern sea lion, and river otter (KiTSA, 2012). Other marine mammals including several species of whales have been occasionally sighted near the Site, but at much lower frequencies.

Representative preliminary receptors for the ERA were selected based on the following criteria:

- Ecological relevance;
- Potential levels of exposure to COPCs;
- Social or economic importance;
- Sensitivity to COPCs; and
- Availability of sufficient natural history information to allow meaningful assessment of exposure and risk.

Exposure pathways relevant to these representative species are presented in Figure 4-4 for aquatic (i.e., fish) and aquatic-dependent (e.g., heron and river otter) receptors and in Figure 4-5 for terrestrial receptors.

Figure 4-4 shows the aquatic wildlife receptors with potentially complete exposure pathways: direct contact with and ingestion of sediment, porewater, and marine water; and consumption of benthic invertebrates, fish, and other potentially contaminated prey. The representative aquatic receptors listed in Figure 4-4 include the following:

- **Piscivorous Mammals (e.g., Harbor Seals).** There is a potential for limited exposure of piscivorous mammals foraging at the Site. The harbor seal was selected to represent mammals with primarily aquatic diets feeding mostly on demersal and pelagic fish with some crustaceans and mollusks. Potentially complete exposures are associated primarily with consumption of aquatic biota and, to a lesser extent, with direct contact with and ingestion of sediment and marine surface water.
- **Piscivorous Raptors (e.g., Ospreys).** There is a potential for limited exposure of piscivorous raptors foraging at the Site. The osprey represents birds that feed primarily on pelagic fish with some demersal fish. Potentially complete exposures

are associated primarily with consumption of aquatic biota and, to a lesser extent, with direct contact with and ingestion of marine surface water.

- **Shore Birds (e.g., Herons and Sandpipers).** There is a potential for exposure of shore birds residing or foraging at the Site. The great blue heron represents birds that feed primarily on demersal fish with some pelagic fish and crustaceans. The spotted sandpiper represents shore birds that obtains much of their diet by probing or “mining” soft sediments along shorelines and that feed on aquatic worms, mollusks, and crustaceans. Potentially complete exposures are associated primarily with consumption of aquatic biota, direct contact and incidental ingestion of sediment, and, to a lesser extent, with direct contact with and ingestion of marine surface water.
- **Piscivorous Fishes (e.g., Rockfish).** Piscivorous fishes feed on higher trophic level species and may be at increased risk from bioaccumulative COCs. Non-listed rockfish represent fish residing or foraging at the Site that may potentially be exposed to Site-related COCs primarily through consumption of fish and direct contact with marine surface water and sediment, incidental ingestion of marine surface water, and to a lesser extent, ingestion of sediment.
- **Omnivorous Fishes (e.g., Sculpins).** Sculpin represent omnivorous fishes residing or foraging at the Site that may potentially be exposed to Site-related COCs primarily through consumption of aquatic biota, direct contact with sediments and marine surface water, incidental ingestion of marine surface water, and to a lesser extent, ingestion of sediment and consumption of other biota.
- **Benthivorous Fishes/Shellfish (e.g., Flatfish, Bivalves, and Crabs).** Benthivorous fish/shellfish prey on infaunal and epibenthic organisms. English sole or other flatfish, and crabs represent benthivorous fishes/shellfish residing or foraging at the Site that may potentially be exposed to Site-related COCs primarily through consumption of biota and through direct contact with and ingestion of sediments and marine surface water, and to a lesser extent through consumption of other biota.
- **Benthic Invertebrates (e.g., Benthic Infauna Community).** Benthic invertebrates residing at the Site may potentially be exposed to Site-related COCs through direct contact with and ingestion of sediments, porewater and marine surface water, and, to a lesser extent, through consumption of other biota.
- **Macrophytes (e.g., Algae and Kelp).** Macrophytes residing at the Site may potentially be exposed to Site-related COCS through direct contact with sediment and porewater and marine surface water.

The upland properties at the Site have historically been developed and used for industrial operations. However, portions of these properties include habitat that could be used by terrestrial ecological receptors. These areas primarily include the vegetated areas of the Former Ravine and the bank. Terrestrial ecological receptors with potentially complete exposure pathways are illustrated on Figure 4-5 and include the following:

- **Avian Predators (e.g., Robins).** There is a potential for exposure of avian predators foraging or nesting at the Site. The robin represents birds that prey on soil invertebrates and, to a lesser degree, fruit. The primary exposure pathways

include the consumption of terrestrial biota and direct contact with and incidental ingestion of Site soil, and to a lesser extent, contact with and ingestion of on-Site surface water.

- **Carnivores (e.g., Coyotes).** There is a potential for limited exposure of carnivores foraging at the Site. The coyote represents upper-trophic level mammals that prey primarily on small mammals and soil invertebrates. The primary exposure pathways for these receptors include the consumption of terrestrial biota and direct contact with and incidental ingestion of Site soil, and, to a lesser extent, contact with and ingestion of on-Site surface water.
- **Omnivores (e.g., Raccoons).** There is a potential for limited exposure of omnivores foraging at the Site. The raccoon is a common, medium-sized, opportunistic feeder with a varied diet depending on season and location; the raccoon was selected to represent mammals feeding primarily on soil invertebrates and plants. The primary exposure pathways for these receptors include the consumption of terrestrial biota and direct contact with and incidental ingestion of Site soil and, to a lesser extent, contact with and ingestion of on-Site surface water.
- **Herbivores (e.g., Voles).** There is a potential for exposure of herbivores residing at the Site. The vole is a common small mammal that consumes shoots, grasses, and bark and is prey for carnivorous mammals and birds. The vole represents mammals feeding solely on plants. The primary exposure pathways for these receptors include the consumption of terrestrial biota, direct contact with and incidental ingestion of Site soil, and, to a lesser extent, contact with and ingestion of on-Site surface water.
- **Insectivores (e.g., Shrews).** There is a potential for exposure of insectivores residing on the Site. The shrew represents mammals feeding primarily on earthworms and other soil invertebrates. The primary exposure pathways for these receptors include the consumption of terrestrial biota, direct contact with and incidental ingestion of Site soil, and, to a lesser extent, contact with and ingestion of on-Site surface water.
- **Upland Vegetation.** There is a potential that plants growing at the Site could be exposed to Site-related COCs in soil. The primary exposure pathways for plants is direct contact with Site-related COCs in the soil.
- **Soil Invertebrates.** There is a potential for exposure of earthworms and other biota living at the Site. The primary exposure pathways for these receptors include direct contact and incidental ingestion of Site-related COCs in soil, consumption of terrestrial biota, and, to a lesser extent, contact with and ingestion of on-Site surface water.

4.4 Preliminary Contaminants of Potential Concern

This Section identifies preliminary COPCs based on: (1) contaminants typically associated with the former gas works process (carbureted water gas); (2) contaminants associated with other potential historical sources within the initial study area (ISA; see Section 5.1); (3) contaminants detected during previous Site investigations; and (4) other EPA contaminants of interest. The COPCs and (following completion of the baseline risk assessments) ultimately the COCs, that are determined to apply to the Site-related

decisions may include some, none, or all of the contaminants identified in this Section. The COCs that are ultimately determined to apply to the Site-related decisions will be established in the baseline risk assessments on the basis of data and information that are collected as part of the RI/FS process (Section 5.2.4).

Contaminants typically associated with carbureted water-gas manufacturing processes include the following:

- Light aromatic hydrocarbons, such as BTEX compounds;
- Heavier aromatic hydrocarbons, including PAHs;
- Other SVOCs, such as tar acids (e.g., phenol and cresols) and heterocyclic aromatics (e.g., carbazole and dibenzofuran); and
- Cyanide and sulfides associated with spent purifier materials.

Other historical processes with the potential for releases at the Site include petroleum transfer and storage, metal fabrication, and vehicle and equipment salvage and repair. Contaminants typically associated with these processes include solvents (VOCs), petroleum hydrocarbons (including BTEX and PAHs), and metals.

Though there are no existing data indicating their presence at elevated concentrations, EPA has identified polychlorinated biphenyls (PCBs), pesticides and dioxins/furans as other contaminants of interest at the Site. PCBs are man-made organic chemicals, manufactured between 1929 and 1979, and used in industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; in paints, plastics and rubber products; and in pigments and dyes. PCBs may still be present in products and materials that were manufactured before 1979, including electrical transformers and capacitors, fluorescent light ballasts, adhesives, oil-based paint and caulking. Pesticides are substances, or mixtures of substances, intended for preventing, destroying, repelling, or mitigating any living organisms (e.g. insects, mice, weeds, fungi, microorganisms) that occur where they are not wanted or that cause damage to crops, humans or other animals. The term pesticides applies to insecticides, herbicides, fungicides, and various other substances used to control pests. Dioxins/furans are a group of toxic chemical compounds that are created unintentionally as a result of human activities, such as production of herbicides, combustion processes (waste incineration or burning wood, coal or oil fuel), and chlorine bleaching of pulp and paper, as well as natural processes like forest fires (<http://www.epa.gov/dioxin/learn-about-dioxin>).

The preliminary COPCs for the Site fall within the following groups of contaminants:

- VOCs, as identified and quantified by EPA Method 8260C.
- SVOCs, including carcinogenic- and non-carcinogenic PAHs, as identified and quantified by EPA Method 8270D/SIM.
- Cyanide, as identified and quantified by EPA Method 9014.
- Metals, as identified and quantified by EPA Methods 200.8/6010/6020/7471B/7196A.
- PCBs, as identified and quantified by EPA Method 8082. Where PCB aroclors are detected by EPA Method 8082 in sediment, additional quantification for PCB congeners will be conducted by EPA Method 1668.

- Pesticides, as identified and quantified by EPA Method 8081B.
- Dioxins/furans, as identified and quantified by EPA Method 1613.

Table 4-3 lists the preliminary COPCs (hereafter referred to as the Site COPCs) and identifies the reason for inclusion, the potential sources of MGP-related contaminants, and the potential human health and environmental concerns related to each contaminant group. The scope of work for the RI will generally include analysis and reporting of the full standard list of contaminants for each analytical method listed above, and described in detail in the Upland SQAPP and Marine SQAPP (Appendices A and B, respectively).²⁵

The data collected during this first phase of work will be screened against initial PRGs. Based on the data gathered during the RI, the baseline risk assessments (to be prepared in parallel with the RI Report) will determine which of the Site COPCs presents an unacceptable risk and will be identified as COCs. COCs identified in the baseline risk assessments will then be carried forward into the FS for the evaluation of remedial options.

²⁵ As described in Section 5.5, certain analyses may be excluded if field observations indicate high levels of contaminants (e.g., tar) that would cause analytical interferences for other compounds (e.g., pesticides), and a tiered approach to selecting samples for dioxin/furan analysis will be implemented.

5 Work Plan Rationale

This Section describes the basis and approach for the RI data collection program. It includes the following information:

- Description and basis for the initial study area (ISA) that is to be characterized during the RI (Section 5.1);
- Summary of data needed to complete the RI and FS (Section 5.2);
- Approach for completing the risk assessment (Section 5.3);
- DQOs for collected data (Section 5.4);
- The approach for filling data gaps (Section 5.5); and
- Potential contingency studies that may be required after initial data collection has been completed (Section 5.6).

Details of the specific sampling and analysis programs for the upland and marine areas are provided in the Upland and Marine SQAPPs (Appendices A and B).

5.1 Initial Study Area

The purpose of defining the ISA is to provide a focused area for sampling and analysis in the initial phase of the RI/FS (AOC, EPA, 2013a). The ISA is not intended to define the Site boundaries. The Statement of Work (SOW) for the AOC anticipates “the ISA will encompass the area of operation of a former manufactured gas plant (MGP)..., including the area where contaminants from the area of operation have come to be located, which includes upland, beach and sediments.” The ISA has been developed according to the guidelines established by the SOW and includes an upland portion and a sediment portion. The rationale for the upland and sediment portions of the ISA is explained further in the following Sections.

5.1.1 Upland Initial Study Area

The upland portion of the ISA (Figure 5-1) includes the Former Gas Works Property and portions of neighboring properties where gas works operations, including byproduct storage and disposal, are documented or suspected to have occurred. This includes the northern portion of the Penn Plaza Property where a drip tank was located and the eastern portion of the Sesko Property where materials from the former gas works process may have been placed in the Former Ravine. The upland portion of the ISA also includes areas where contamination associated with operations other than the former gas works could potentially be commingled with contamination from the gas works. These non-gas-works operations include the former Lent’s bulk petroleum storage tank farm on the Sesko Property, petroleum pipelines located in the northern portion of the Penn Plaza Property and the Sesko Property, and various light industrial operations on the McConkey and Penn Plaza Properties.

Consistent with the SOW, the proposed ISA encompasses all upland areas where contaminants associated with the former gas works are likely to be located. The existing data collected from areas near the boundaries of the ISA suggest that contamination associated with the former gas works may not extend beyond the ISA. More data are needed to determine if this is the case. The existing data include the results of soil and groundwater sampling from well MW-1 on the Penn Plaza Property, borings MP03 and MP02 within Thompson Drive, borings SP01 and SP02 on the Sesko Property, and explorations associated with the Former SC Fuels Property to the east of the ISA.

The first phase of the RI will characterize the nature and extent of contamination within the ISA and assess the subsurface characteristics that may influence the migration of contaminants. These data will be used to determine where additional investigation may be warranted. Investigations outside of the ISA, if needed, would then be specifically designed and implemented to focus on the characterization of identified issues.

5.1.2 Sediment Initial Study Area

The sediment portion of the proposed ISA (Figure 5-2) comprises intertidal and subtidal areas in the general vicinity of the Former Gas Works Property. The sediment portion of the ISA is described as follows:

- Historical potential source areas associated with the former gas works (including the Former Gas Works Dock and the former drainage line) have been included.
- All beach sediments adjacent to the Former Gas Works Property that exhibited elevated PAH concentrations during the 2013 TCRA have been included.
- The offshore boundary of the ISA extends out past midchannel in the Port Washington Narrows, well past the bathymetric low point in the channel. This addresses potential migration pathways associated with groundwater and/or NAPL migration and those associated with potential sediment transport.
- The eastern and western boundaries of the ISA extend between 500 and 1,000 feet in an east-west direction from the Former Gas Works Property, allowing documentation of the potential transport of sediments that may have resulted from the east-west tidal currents within the Port Washington Narrows.

The sediment portion of the ISA includes multiple potential sources that are unassociated with historical activities on the Former Gas Works Property: multiple historical petroleum transfer docks, multiple stormwater and CSO outfalls, and the Port Washington Marina.

As part of the RI/FS activities related to sediments, there is a need to understand sediment transport processes that may affect either current or future Site conditions. Therefore, sampling activities for sediments and surface water will not be exclusively confined to the ISA. Some sampling during the RI/FS will occur outside the sediment portion of the ISA. However, the investigation and remediation of non-Site-related contaminant sources that are located outside the ISA is not an objective of this RI/FS.

5.2 Data Needs

The data needs have been identified through the RI/FS scoping process and development of the Scoping Memorandum (Aspect and Anchor QEA, 2015). This Section discusses the

data needs that affect all components of the RI/FS process. The general data needs, specific data gaps, and planned RI data collection methods for the upland and marine portions of the Site are summarized in Tables 5-1 and 5-2, respectively. The general approach for addressing the data needs is summarized in Section 5.5.

5.2.1 Upland Data Needs

5.2.1.1 Site Physical Characteristics

Characterization of the physical properties of the soil is necessary to evaluate the contaminant migration pathways and the remedial options. Soil samples will be collected from all typical lithologic units, as feasible, for physical characterization to include grain size, density, moisture content, and organic carbon content.

The data needs associated with the hydrogeology of the Site include data to define aquifer and aquitard units across the Site, evaluate the hydraulic conductivity of aquifer units, and understand the influence of tidally influenced surface water on groundwater flow and contaminant transport from the Site. The installation and sampling of groundwater monitoring wells is needed to provide these physical data, as well as samples to define the extent of groundwater contamination. The distribution of groundwater contaminants is associated with groundwater flow, which may be affected by seasonal variations in groundwater levels due to precipitation, as well as interaction with surface water. The information needed to satisfy these data needs will be obtained by sampling groundwater for chemical and geochemical parameters, logging geologic information, measuring static and transient water levels, and performing aquifer testing.

5.2.1.2 Nature and Extent of Contamination

A primary objective of the RI is to delineate the nature and distribution of contamination in the potentially affected media at the Site, which include soil, groundwater, air, surface water, and sediment. Samples of each potentially affected medium will be collected for chemical analysis of the Site COPCs throughout the RI process.

Also important in understanding the nature and extent of contamination is to identify and delineate contaminant source materials such as NAPL. As described in Section 3.7.1, NAPL has been observed in Site soil. Based on historical Site use, both LNAPL (density is less than that of water) and DNAPL (density is greater than that of water) may be present. If there is sufficient volume and the soil is sufficiently permeable, both LNAPL and DNAPL will migrate downward via gravity flow through the soil. Because it is less dense than water, LNAPL will begin to migrate laterally when it encounters groundwater, primarily in the direction of groundwater flow. DNAPL is denser than water and will continue to sink below the water table. As it migrates downward, both in the vadose zone and through the water-bearing zone, NAPL leaves behind a residual coating of product on the soil grains, which can be used as an indicator of the potential presence of NAPL.

DNAPL will continue to migrate downward via gravity flow until the available volume of mobile DNAPL has been depleted or until a soil layer with lower permeability is encountered. DNAPL may collect in pools on top of low-permeability layers and migrate laterally through seams of higher permeability soil. Downward vertical migration of DNAPL below the water table can also be slowed or eliminated by an upward hydraulic

gradient. Along with the evaluation of the presence of NAPL, the geologic and hydrogeologic conditions at the Site will be characterized as part of the evaluation of potential NAPL mobility.

Because NAPL is a hazardous substance, but also a potential source of contaminants to other media, the characterization of the presence, nature, and extent of NAPL will be another primary objective of the RI. The data needs associated with NAPL include investigation to identify its presence, collection of data to delineate its lateral and vertical extent in the subsurface, and laboratory testing to evaluate its composition and mobility. The information needed to satisfy these data needs will be obtained by field screening soil, gauging monitoring wells for the presence of NAPL, evaluating chemical data from soil, groundwater, and sediment for indications of NAPL presence²⁶, and, if feasible, collecting NAPL samples for physical and chemical testing.

5.2.1.3 Contaminant Fate and Transport

Contaminants present in Site media may migrate from one location to another via the fluid flow processes of advection or diffusion, transfer between media via partitioning mechanisms, and attenuate as the result of physical, chemical, or biological processes. Contaminants can also be transformed into different chemicals or destroyed by biological or chemical reactions. Understanding contaminant migration and transformation across the Site is important for evaluating potential exposure pathways, anticipating how the nature and extent of contamination may change over time, and evaluating the potential effectiveness of remedial actions, including estimating the restoration time frame. The potential contaminant migration pathways and transformation processes are described in detail in Section 4.2.

To evaluate fate and transport of upland contaminants, it will be necessary to collect data to evaluate potential medium-to-medium migration pathways and NAPL migration pathways (Table 5-1). The data needs associated with the evaluation of upland contaminant fate and transport include data to define the physical characteristics of soil and NAPL, define the physical characteristics of aquifers and aquitards, evaluate natural attenuation and degradation of contaminants in soil and groundwater, and evaluate groundwater chemical data to assess spatial and temporal trends. Information obtained to determine the physical characteristics of the Site (Section 5.2.1) and the nature and extent of contamination (Section 5.2.2) will be used to evaluate contaminant fate and transport. The additional information needed to satisfy these data needs will be obtained by the collection and analysis of groundwater samples for specific indicators of natural attenuation or degradation of contaminants, including geochemical indicators of contaminant degradation and the evaluation of groundwater data for changes in contaminant concentrations along a chemical flow path or over time.

²⁶ Concentrations of hydrocarbons in soil greater than 10,000 mg/kg generally indicate the potential presence of tar or NAPL (Cohen and Mercer, 1993). The detection of benzene, naphthalene, or PAHs in groundwater at a concentration greater than 10 percent of each contaminants' solubility suggests that NAPL may be present at or upgradient of that location.

Data collected to inform the evaluation of contaminant transport within and between environmental media and evaluate potential mechanisms for contaminant attenuation include:

- Physical soil characteristics, including soil type, grain size, density, and TOC content, to support the analysis of migration pathways including the potential for contaminants to leach from soil into groundwater and to sorb to soil from groundwater.
- Hydraulic characteristics, including hydraulic conductivity, groundwater gradients, and tidal influences, to evaluate groundwater flow and associated contaminant transport.
- Groundwater geochemical data, including dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, ferrous iron, dissolved manganese, alkalinity, pH, dissolved oxygen and oxidation-reduction potential, to evaluate natural attenuation and biological and chemical degradation of contaminants.

Geochemical data and the change in chemical concentrations along groundwater flow paths may be used for qualitative evaluations of the occurrence of contaminant degradation or for qualitative evaluations in conjunction with contaminant fate-and-transport groundwater models.

Temporal data collected at a Site well network will be used to assess seasonal trends (e.g., by looking at fluctuations during quarterly sampling events) in contaminant transport and longer-term trends to assess whether contaminant plumes are stable, expanding, or shrinking.

Soil and groundwater chemical data, along with physical characteristics, will be used to evaluate potential migration pathways to soil vapor and indoor air. The potential for vapor intrusion will be assessed in accordance with guidance (EPA, 2015) and may include vapor intrusion modeling (e.g., the Johnson-Ettinger model) to assess potential impacts under current or future uses. Potential additional soil vapor or indoor air studies are discussed in Section 5.6.

5.2.1.4 Risk Assessment

The data needs for the risk assessment generally overlap those for the RI and FS. Specific types of information required to support the development of a baseline human health risk assessment (HHRA) and a baseline ERA for the upland areas include the following:

- Conduct supplemental testing within the upland portion of the ISA to finalize the list of Site COPCs for the upland area.
- Determine the nature and extent of contamination in surface soil and subsurface soil to assess risks for human and ecological receptors.

- Develop sufficient data to estimate potential risks related to the effect of contaminant vapor on indoor air quality, including shallow subsurface soil and/or groundwater quality data or soil vapor data.
- Determine the nature and extent of contamination in groundwater to assess risks for human and ecological receptors.

5.2.2 Marine Data Needs

5.2.2.1 Site Physical Characteristics

To evaluate physical forces and overall geologic formations in the sediment portion of the ISA and the adjacent portions of the Port Washington Narrows, evaluations of current velocity, and sediment substrate studies by means of a towed video camera are needed. Current velocity will be measured at two depth profiles (near-bottom and mid-channel) along each transect and will be used to indicate potential impacts of current velocity on sediment stability within the ISA and the Port Washington Narrows. Sediment grain size results will be used in conjunction with modeled wind/wave and measured tidal current velocities to evaluate intertidal and subtidal sediment transport processes in the Port Washington Narrows.

Similarly, towed-camera surveys will be conducted to document the sediment substrate type, natural, and anthropogenic features in perpendicular and parallel transects in the vicinity of the sediment ISA and the adjacent Port Washington Narrows.

5.2.2.2 Nature and Extent of Contamination

A primary objective of the RI is to delineate the nature and lateral/vertical distributions of contamination in the surface water and sediment. Samples of each potentially affected medium will be collected for chemical analysis of the Site COPCs²⁷ throughout the RI process.

Because NAPL is a hazardous substance, but also a potential source of contaminants to other media, the characterization of the presence, nature, and extent of NAPL will be another primary objective of the RI. The data needs associated with NAPL include investigation to identify its presence, collection of data to delineate its lateral and vertical extent in the subsurface, and laboratory testing to evaluate its composition and mobility.

5.2.2.3 Contaminant Fate and Transport

To evaluate fate and transport of marine contaminants, it will be necessary to collect data to evaluate medium-to-medium migration pathways and NAPL migration pathways. These data needs will be satisfied by an evaluation of surface sediments, surface sediment porewater, subsurface sediments, surface water, and physical characteristics of sediments. In addition, data are needed to characterize the physical mechanisms of transport within

²⁷ Analysis of sediment samples will include tiered approaches for VOCs, PCB congeners, and dioxin/furans as described in the Marine SQAPP (Appendix B, Section 3.1.3). Surface water samples will be analyzed for all Site COPCs, except for dioxins/furans.

the Port Washington Narrows to determine potential transport through surface water, sediment littoral drift, and sediment bed load mobility.

5.2.2.4 Risk Assessment

The data needs for the risk assessment generally overlap those for the RI and FS. Specific types of information required to support the development of a baseline human health risk assessment (HHRA) and a baseline ERA for the marine areas include the following:

- Conduct supplemental testing within historical source areas to confirm the list of Site COPCs for the marine investigation.
- Determine the nature and extent of Site-associated PAH contamination in surface sediments.
- Evaluate potential PAH contamination in surface water within the marine portion of the ISA.
- Determine the nature and extent of Site-associated PAH contamination in subsurface sediments in the beach area for use in evaluating potential risks for beach construction workers.
- Assess the partitioning behavior of PAHs in surface sediment using solid-phase microextraction (SPME) to inform whether literature-based partitioning estimates provide a reasonable basis for estimating bioavailability, or whether additional data are needed to perform the risk assessment.
- Where warranted following initial data collection and in consultation with EPA and the Tribe, implement contingent bioassay testing and/or sediment porewater testing to augment sediment and porewater data and evaluate potential impacts on benthic infaunal communities.
- Following initial data collection and in consultation with EPA and the Tribe, implement tissue testing of selected species for development of exposure point concentrations and evaluation of potential risk from aquatic species that are harvested by seafood consumers or that serve as prey for high trophic level ecological receptors.
- Use video surveys to augment available literature regarding the aquatic species that may use the Site and vicinity.
- Use beach surveys to assess the presence of shellfish resources potentially subject to harvest activities in beach areas near the Site.

Section 5.3 describes how each of the data collection activities will be used in support of the risk assessment activities.

5.2.3 COC Identification

The scope of work for the RI/FS will include collection and analysis of samples for Site COPCs and contaminants of interest (see Section 4.4) to support the identification of Site COCs, which are those contaminants identified to be present at concentrations that pose a potential risk to human health or the environment in media for which there is a potential complete exposure pathway. The final COCs will be defined based on the results of the baseline risk assessments (Section 5.3). The basis for eliminating a contaminant or contaminant group as a COPC include the following:

- The contaminant is a naturally occurring compound and is detected within the range of a documented natural background concentration.
- The contaminant is not identified as a COC in the baseline human health or ecological risk assessments (see Section 5.3).

5.3 Risk Assessment Approach and Methodology

Consistent with the AOC, a baseline ERA and HHRA will be performed to support the RI/FS decision-making. The baseline risk assessments will be completed in parallel with the preparation of the Draft RI Report. While the initial phase of investigation is being completed, ongoing consultation with the EPA and the Tribe will be conducted to identify risk-based PRGs for seafood consumption. The seafood consumption-based PRGs will be included in the Risk Assessment Technical Memorandum. The Risk Assessment Technical Memorandum will identify any data gaps and the means by which they should be addressed (e.g., seafood tissue sampling, additional soil, or sediment testing).

The data collection activities associated with the risk assessment will be conducted as part of the Site characterization activities. The planned data collection activities will address the data needs for completion of the risk assessment for all receptors and exposure scenarios identified in Section 4.3.

The specific risk assessment plan for the HHRA is presented in Table 5-3. The risk assessment plan for the baseline ERA is presented in Tables 5-4 and 5-5. The tables provide the following information:

- The receptor to be evaluated;
- The evaluation framework to be used to estimate potential risks for that receptor under the specific exposure scenario;
- The RI data that will be used in support of the risk assessment for the specific exposure scenario; and
- The endpoint and interpretive framework to be used to quantify potential risks.

5.3.1 Risk Assessment Technical Memorandum

An interim deliverable, the Risk Assessment Technical Memorandum, will be used to document the preliminary screening of the collected RI data and provide a detailed description of the methods to be used for the baseline risk assessments. The Risk

Assessment Technical Memorandum will define the scope and methods for tissue testing required to complete the Baseline Risk Assessments. The Risk Assessment Technical Memorandum will be prepared in conjunction with the Phase 1 Data Report,²⁸ which is discussed further in Section 6.3. Risk-based PRGs for seafood consumption will be developed in consultation with the EPA and the Tribe.

The Risk Assessment Technical Memorandum will provide the following information identified in Tables 5-3, 5-4, and 5-5:

- The specific data to be used for the evaluation of each exposure scenario;
- Results of preliminary data screenings;
- Statistical approaches (where applicable) to be used to estimate exposure point concentrations for each exposure scenario;
- Description of any models or calculations to be used to estimate exposures, including the following:
 - Methods used to estimate soil vapor and indoor air quality from soil and groundwater data;
 - Source of any biota-sediment accumulation factors to be used to estimate the bioaccumulation of sediment contaminants in aquatic species;
 - Partitioning coefficient values used to estimate porewater quality from bulk sediment data;
 - Models and parameters used to estimate the total daily intake of contaminants for each receptor; and
 - The rationale for seafood consumption rates used for fish and shellfish consumption exposure scenarios, as developed in consultation with EPA and the Tribe.
- Applicable toxicity information and exposure parameters; and
- Current screening levels, benchmarks, and toxicity reference values to be used in the ERA and HHRA.
- Method used to identify Site COPCs retained for the HHRA and ERA.

The Risk Assessment Technical Memorandum will also identify data gaps and contingent testing activities (where applicable) to be implemented in support of the risk assessment. The data gap identification will include the environmental media (e.g., soil, sediment, tissue) and COPC/COPC group where data are insufficient to prepare the ERA or HHRA. Any proposed testing activities will be documented in an addendum to this Work Plan in accordance with the AOC (see Section 6.2).

²⁸ In the AOC, this report is also called the RI/FS Data Report.

5.3.2 Human Health Risk Assessment

The HHRA methodology will be based on national and regional guidance designated by EPA, including, but not limited to, the following:

- Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Parts A through F (EPA, 1989);
- Interim Guidance: Developing Risk Based Clean-up Levels at Resource Conservation and Recovery Act Sites in Region 10 (EPA, 1998a);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, Final) (EPA, 2004);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (EPA, 2009);
- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (EPA, 2014);
- The Exposure Factors Handbook (EPA, 2011); and
- The Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia (EPA, 2007).

Toxicity data will be developed on the basis of the EPA hierarchy of human health toxicity values (EPA, 2003). Any updates to the above sources will be documented in the Risk Assessment Technical Memorandum.

The Draft Baseline HHRA Report will be submitted to EPA 180 days after the receipt of validated data from samples collected during the Site characterization activities. The Final Baseline HHRA Report will be included in the Final RI Report.

5.3.3 Ecological Risk Assessment

The ERA methodology will address both terrestrial and aquatic ecological exposures for the receptors identified in Section 4.3. The ERA methodology will be based on EPA guidance, including, but not limited to, the following:

- Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments, (EPA, 1997a)
- Guidelines for Ecological Risk Assessment (EPA, 1998b); relevant and appropriate updated EPA guidance material (e.g., EPA's Eco Updates)
- EPA Region 10 Supplemental Ecological Risk Assessment Guidance for Superfund (EPA, 1997b).

Toxicity data will be developed in accordance with EPA guidance (e.g., EcoSSLs) and databases (e.g., Ecotox), peer-reviewed scientific literature, and recent EPA-approved risk assessments. Any updates to the above sources will be documented in the Risk Assessment Technical Memorandum.

The Draft Baseline ERA Report will be submitted to EPA 180 days after the receipt of validated data from samples collected during the Site characterization activities. The Final Baseline ERA Report will be included in the Final RI Report.

5.4 Data Quality Objectives

The data needs for the RI/FS have been developed through a methodical planning process to ensure appropriate sampling, analyses, and data evaluations are conducted to meet the RI/FS objectives. EPA's Guidance on Systematic Planning Using the Data Quality Objective Process (EPA, 2006) was used to acquire the necessary data to develop the RI/FS, through a process called Data Quality Objectives (DQO). The seven-step DQO process is a tool to determine the type, quantity, and quality of data necessary for any subject analysis. The seven steps are:

1. State the problem;
2. Identify the Goal of the Study;
3. Identify Information Inputs;
4. Define the Boundaries of the Study;
5. Develop the Analytic Approach;
6. Specify Performance or Acceptance Criteria; and
7. Develop the Plan for Obtaining the Data.

DQOs were developed to address the data needs summarized in Tables 5-1 and 5-2. The following 10 DQOs have been identified to complete the RI/FS:

1. Contamination in Soil and Groundwater (Table 5-6)
2. Source of Contamination (Upland) (Table 5-7)
3. Site Physical Characteristics (Table 5-8)
4. NAPL Characterization (Table 5-9)
5. Contaminant Fate and Transport (Table 5-10)
6. Habitat and Intertidal Shellfish Surveys (Table 5-11)
7. Contamination of Surface Sediment (Table 5-12)
8. Contamination of Subsurface Sediment (Table 5-13)
9. Contamination of Surface Water (Table 5-14)
10. Marine Area Current and Sediment Transport Processes (Table 5-15)

These DQOs are summarized in Tables 5-6 through 5-15, and are further detailed in Section 5.5. The characterization approach to fulfill these DQOs is described in the following Sections.

5.5 Remedial Investigation Approach

This Section presents the general approach for characterizing the Site and addressing data gaps related to the upland and marine portions of the Site. The CSM will be continuously updated as data is collected and evaluated to modify sampling locations and approaches to meet the objectives of each phase of the investigation. Specific sampling and analysis details including preliminary exploration locations, sampling and analysis rationale, and field procedures are provided in the Upland SQAPP (Appendix A) and Marine SQAPP (Appendix B).

5.5.1 Upland Investigation

The upland investigation will be conducted sequentially to adaptively manage the scope of work to address specific objectives. The investigation will start with evaluating potential sources and work its way out from those sources to determine the nature and extent of contamination at the Site. The upland RI activities will consist of five general phases of work, as follows:

1. Geophysical Investigation.
2. Source Characterization.
3. Source Areas Investigation.
4. Outside Source Areas Investigation.
5. Groundwater Testing and Monitoring.

Data gathered during each step of the field investigation will be used to guide subsequent data collection.

A detailed scope of work, including objectives, approach, and proposed explorations, for performance of the Geophysical Investigation and the Source Characterization is provided in the following sections. These two components will be sequenced so that the results of the Geophysical Investigation can be reviewed before the Source Characterization to determine whether additions or modifications to the scope of work are warranted.

The objectives and approach for the Source Areas Investigation and the Outside Source Areas Investigation are also discussed in the following sections. These include a rationale for determining exploration methods, locations, and other details, such as depth and sampling intervals. Some details, such as the number, location, and depth of explorations, will be determined based on the results of the preceding steps.

This Work Plan is designed to provide sufficient detail to enable decision-making by the project team in the field, to streamline the investigation program. Key decision points or unanticipated conditions that would require consultation with EPA for resolution are identified. A field communication plan to ensure that field activities and data are communicated to the Cascade and EPA project teams in a timely manner is included in Appendix A and summarized in Section 9.2.

Depending on the results of the upland investigation, contingent investigations or studies that would require an addendum or addenda to this Work Plan may be warranted. Some potential contingent investigations are described in Section 5.6. The process for planning and reporting on additional phases of investigation work is described in Section 6.2.

5.5.1.1 Geophysical Investigation

The Geophysical Investigation will consist of geophysical and utility surveys to provide preliminary information regarding subsurface conditions. The primary objective of the Geophysical Investigation is to evaluate the former gas works operations area and the Former Ravine for potential buried structures (i.e., piping, tanks and equipment foundations) or anomalous ground conditions that may indicate historical use of the subsurface (i.e., covered and filled pits) or fill material. The surveys will also be used to identify active storm drain lines or other existing utilities. The results of the surveys will be used to identify potential sources for further assessment in the Source Characterization, and to determine if adjustments to the Source Characterization, such as moving or adding explorations to investigate observed anomalies, are warranted.

The geophysical surveys, including the field data collection and interpretation, will be completed by hydroGEOPHYSICS, Inc. Three separate geophysical surveys will be conducted successively, as described below, to meet different objectives in different areas of the Site.

5.5.1.1.1 Electromagnetic Induction (EM) Survey.

The objective of the EM survey is to identify subsurface metallic objects, variations in soil moisture content that may indicate shallow subsurface filled pits or trenches, and to identify areas where shallow subsurface fluid or contaminant has pooled. Electromagnetic field data are collected using portable ground conductivity instrumentation. A transmitting coil induces an electromagnetic field and a receiving coil at a fixed separate distance measures the amplitudes of the in-phase and quadrature components of the electromagnetic field. The in-phase component is most sensitive to metallic objects. The quadrature (also referred to as conductivity) component is sensitive to soil condition variations. High density EM data covering large areas can be collected within a short time period and readily processed and visualized for quick interpretation. Depending on subsurface conditions, EM data can evaluate conditions up to 15 feet below ground surface.

The EM survey area includes the entirety of the upland portion of the ISA except for the Shoreline fill area, where the character of the slope prevents safe data collection, and the nearshore section of the marine portion of the ISA, as depicted on Figure 5-3.

Electromagnetic induction data will be acquired along parallel survey lines over the survey area at a line spacing of approximately 3 feet, varied as necessary based on accessibility. EM data will not be collected where buildings or immobile metallic objects are located at the ground surface because of potential electromagnetic interference. The EM data is expected to be collected within one day and can typically be processed and visualized overnight to allow for an evaluation of the findings and refinement of the approach for the ground penetrating radar (GPR) survey.

5.5.1.1.2 Ground Penetrating Radar Survey

The GPR survey will provide targeted, high resolution characterization of the location, size and dimensions of subsurface metallic objects on the McConkey Property identified during the EM survey. In addition, the GPR survey will evaluate the McConkey Property for non-metallic subsurface infrastructure and variations in subsurface conditions that may be indicative of covered and filled pits or limits of fill material. The GPR survey will only be completed on the McConkey Property because of uneven or poorly accessible ground surface conditions on other portions of the Site that prevent GPR equipment mobilization.

GPR data will be collected along orthogonally arranged lines at a distance of approximately 6-feet over areas of interest identified in the EM survey, with a maximum survey area of the entire paved or bare and accessible portions of the McConkey Property (Figure 5-3). The data will be collected using a Sensors and Software Noggin 250 Smartcard, which includes a 250 MHz shielded antenna, with a maximum depth of penetration of 8 to 10 feet depending on soil conductivity. GPR data will be filtered and processed by the geophysical consultant in the office using software to reduce noise within the data while drawing out GPR targets and identifying the location and depth of any GPR targets detected.

5.5.1.1.3 Electrical Resistivity Survey

The electrical resistivity (ER) survey will be used to provide high resolution, 2-dimensional cross-sections through the subsurface of the Former Ravine to determine the lateral limits and depth of fill material. The ER technique is assumed to be well suited to meet this objective based on the anticipated contrast in electrical properties between the fill material and the native lithology.

The ER survey will be performed using a SuperstingTM R8 multichannel electrical resistivity system and 18-inch long electrodes, installed 8- to 10- inches into the ground, on 2-foot spacing along three transects across the Former Ravine (Figure 5-3). This will provide high resolution imaging and an expected depth of investigation of approximately 30 feet.

5.5.1.2 Source Characterization

The objective of the Source Characterization is to identify, delineate and characterize sources at the Site. A 'source' is defined as media that exhibits gross contamination such as tar or NAPL; materials coated by, or saturated with, NAPL; or other MGP-related feedstocks or byproducts such as ash, slag, or purifier waste. Field observations that may indicate source material are identified in Appendix A.

The specific objectives of the Source Characterization are to:

- Identify and delineate subsurface features (such as tanks, sumps, and piping) that may be associated with sources;
- Identify and evaluate sources at the Site;
- Delineate the lateral and vertical extent of sources; and
- Identify the Site COPCs associated with each source.

The scope of work for the Source Characterization has been developed based on what is currently known about the Site and its operational history, and does not include any

planned explorations on the eastern side of the Sesko Property or around the southwest corner of the upland ISA because there are no known or suspected historical sources located in these areas²⁹. However, if the geophysical surveys identify any subsurface anomalies warranting investigation in these areas, additional explorations will be added to the Source Characterization. Results of the Geophysical Investigation and proposed modifications to the Source Characterization will be reviewed with EPA prior to conducting the Source Characterization.

This section is organized as follows:

- Characterization Methods and Process
- Exploration Locations
- Sample Collection and Analysis

5.5.1.2.1 Source Characterization Methods and Process

In shallow soils, test pits and trenches are likely to be more effective than borings at evaluating the presence and characteristics of sources because of the ability to make more extensive observations. Direct-push probes will be used in areas where test pits and trenches are impracticable (e.g., beneath or adjacent³⁰ to structures) and may be used to vertically delineate sources at depths beyond what is achievable with test pits or trenches. However, because of the density of native glacial soils beneath the former gas works operations area and the suspected presence of buried debris in the Former Ravine, the practical depth of direct-push soil borings at the Site is expected to also be limited to relatively shallow soils. Deeper borings, if needed to characterize or delineate sources, would be advanced using hollow-stem auger or sonic drilling methods³¹.

The process for identifying, characterizing, and delineating suspected sources using trenches is as follows:

1. Excavate a trench to observe subsurface conditions in the vicinity of the suspected source. The trenches will be aligned to provide the highest probability of encountering a source, if present, based on available historical information.
2. If a subsurface feature representing a potential source (e.g., sump, tank or pipe) is observed, the extent of the feature will be determined through excavation to identify the limits of the feature as practicable³².

²⁹ There is the potential for unknown sources to be present that may not be identified by geophysical methods. The Outside Source Areas Investigation (Section 5.5.1.4) will provide additional exploration of areas outside of known source areas.

³⁰ Trenches generally will not be excavated at locations and depths that would result in greater than a 1.5:1 H:V slope from building foundations.

³¹ Source Characterization activities will be scheduled and sequenced to minimize delays in mobilizing additional equipment to the Site if needed. For instance, a sonic drill rig may be contingently scheduled in advance to follow direct-push borings. If a direct-push boring reaches refusal, Source Characterization explorations (i.e., trenches or direct-push borings) in other areas of the Site may be advanced pending mobilization of larger equipment.

³² Shallow historic/abandoned piping may be excavated and removed, if practicable and necessary to meet the objectives of the Source Characterization. The removal of piping will be completed through

3. If a source is observed:
 - a. The trench will be extended to determine the lateral extent and dimensions of the source as practicable, in the same manner as the investigation into the extent of a subsurface feature described above. Where trenching cannot define the extent of a source, other methods of investigation will be used to meet the objectives.
 - b. At the location where the source is strongest (i.e., more extensive or more highly contaminated), a cross-trench (approximately perpendicular to the original trench) will be excavated to determine the lateral extent and dimensions of the source.
 - c. Once identified and delineated laterally, the vertical extent of each source or source area will be determined by advancing at least two soil borings immediately adjacent to the source/source area³³.
4. The source will be considered delineated when field observations no longer indicate gross visible contamination, strong odors, or significantly elevated PID readings, as determined and documented by the field lead.

At locations or depths where trenches are not feasible, direct-push borings with continuous core soil samples will be used to determine the presence of source material and delineate the lateral and vertical extent of sources. If source material is observed at a boring, step-out borings in opposite directions at 20-foot intervals will be advanced. Similar to trenches, a cross-transect of borings at 20-foot intervals will be advanced at the location where the source is strongest, based on field observations.

If explorations onto adjacent street rights-of-way or properties are needed, approval by the property owners (e.g., via an access agreement or street-use permit) will be sought. If further investigation into piping location is warranted beyond practicable excavation limits, other methods may be employed to meet the investigation objectives (i.e. utility location, GPR surveys, etc.). If piping remains in place beyond the feasible extent of removal, the end will be capped and sealed, and the GPS coordinates of its location will be recorded for future reference. If the origin of the piping remains unclear at the limits of feasible removal, a camera survey or further geophysical survey may be conducted in an attempt to identify its origin and historic use.

Source Characterization explorations will be completed through fill materials and into native soils, where practicable. Soil borings completed to delineate the vertical extent of each source or source area will be advanced to 16 feet below ground surface or to 6 feet

excavation and removal from the ground to a practicable extent, which may correspond to subsurface limitations (e.g. a building foundation), an aboveground structure, property boundaries beyond which excavation work may require street use permits or approvals of adjacent property owners, a depth beyond which an exploration excavation is no longer feasible without structural support or shoring, or other practicable limits. The pipe will be capped or plugged at the practicable limits of exploration and removal.

³³These source delineation borings will not be advanced through the source material to minimize potential for carry down of contaminants on drilling equipment. If it is necessary to drill through the source material, because of access or other logistical limitations, appropriate drilling methods and precautions (see Appendix A) will be employed to minimize potential carry down.

below the source material, whichever is deeper, unless refusal is met shallower. If refusal is encountered within fill material (e.g., on buried debris) before the target depth is reached, the boring will be relocated within five feet of the previous location. If refusal is met a second time, the exploration location will be abandoned and alternative investigation methods will be evaluated. If refusal is encountered due to dense native soils before the target depth is reached, alternative drilling methodologies (e.g., hollow-stem auger or sonic) will be employed to reach the target depth.

Trenches will be completed to native soil or a minimum depth of 6 feet bgs, unless health and safety considerations (e.g., sidewall sloughing) dictate otherwise. The maximum depths of test pits and trenches will be determined by the field lead based on the source being investigated, observations made during the investigation, the subsurface lithology and the limitations of the equipment given the location and surface conditions of the exploration. As examples:

- Explorations intended to evaluate potential releases from surface sources, such as aboveground tanks used to store oil, gasoline or finished gas, will be completed at 6 feet bgs if no indications of releases are observed. If source material is observed in the exploration, the exploration will be completed to define the vertical extent of source material or the maximum depth that is safely feasible, whichever is shallower.
- Explorations intended to evaluate potential releases from shallow subsurface sources, such as underground piping or structures such as tar wells, will be completed at depths sufficient to determine the depth of the structure and the conditions beneath the structure, and to a minimum 6 feet bgs if no indications of releases are observed.
- Explorations to evaluate the gas holder as a suspected subsurface source area will be completed at depths sufficient to determine the depth of the gasholder and the conditions at the base of the gasholder, or the maximum depth that is safely feasible, whichever is shallower.
- Explorations intended to evaluate the character of fill material in the Former Ravine will be completed to the shallower of native soil or the maximum safe depth of exploration, if surface conditions/ground stability will not safely support construction equipment large enough to extend the exploration deeper.

5.5.1.2.2 Exploration Locations

Proposed exploration locations, based on current information, are shown on Figure 5-4. These include evaluation of former gas works features and fill areas, as follows:

- **Former Gas Works Features.** Former gas works features, such as the gas holder, process equipment, and feedstock and byproduct storage areas, are a logical place to start the Source Characterization as those features may have resulted in releases, deposition or burial of source material. The locations of the former gas works features and the Source Characterization explorations to evaluate them are shown on Figure 5-4. Some of these features are visible today. The location of the former gas holder is evident as a circular outline in the asphalt. Likewise, there is an expression in the asphalt in the approximate location of the former scrubber. Additionally, a portion of the concrete slab where the coal/coke briquettes were stored is still present and visible at the ground surface. The locations of other former gas works features and other potential source areas will be estimated using

field global positioning system (GPS) equipment based on their approximate coordinates obtained from georeferenced historical aerial photographs.

Trenches are impractical in the vicinity of the former tar pit because of a building overlying this area (Figure 5-4). Five soil borings will be advanced inside of the building to evaluate the former tar pit. If a source is observed in any one of the borings by the field lead, a step-out exploration will be completed at a distance of approximately 20 feet from the original boring. Step-out explorations outside of the building may be completed as either another boring or as an excavated trench, based on the target depth and field conditions.

- **Ravine and Shoreline Fill Areas.** Sources may also be present in/as fill material in the ravine or along the shoreline. The Source Characterization will include excavation of trenches in these areas to evaluate the nature and extent of fill material, including confirming the extent of fill material, as practicable given safety limitations, and to identify and characterize sources. Preliminary trench locations for the Source Characterization are depicted on Figure 5-4.

Manhole A is currently filled with concrete debris and dirt, which is unlikely to be successfully removed without the removal of the manhole structure itself. Therefore, the Source Characterization will include the removal of Manhole A through excavation and temporary shoring, observation of surrounding soils, and a camera survey of any inlets identified.

The results of the Geophysical Investigation may indicate subsurface anomalies, lateral and vertical limits of fill material, and/or buried metallic objects outside of the current proposed exploration plan. Source Characterization explorations may be modified or added based on the results of the Geophysical Investigation as follows:

- Explorations will be completed in locations where a buried metallic object is identified through the EM and GPR surveys.
- Explorations will be completed in locations where EM and GPR survey results identify subsurface anomalies on the McConkey Property that may indicate filled pits, concrete structures, pooled fluids or buried debris.

5.5.1.2.3 Sample Collection and Analysis

Soils collected from borings, test pits, and trenches will be characterized by soil type and field screened for indications of COPC impacts and NAPL presence (as discussed in more detail in the Upland SQAPP [Appendix A] and Section 5.5.1.2.3), and the results will be recorded. Continuous soil samples will be collected from soil borings for logging and field screening.

To evaluate the Site COPCs associated with identified sources, samples of source materials (e.g., NAPL or NAPL-coated soil) will be collected and analyzed for Site COPCs (VOCs, SVOCs, cyanide, metals, PCBs, pesticides, and dioxins/furans) using the methods described in the Upland SQAPP (Appendix A)³⁴. At least one representative

³⁴ Except a tiered approach will be used to select soil samples for analysis of dioxins/furans, following the protocol described in Section 5.5.1.3.1.

sample of each distinct source material will be collected for chemical characterization. If sufficient free-phase NAPL can be collected, NAPL samples will also be collected and submitted for petrophysical testing (density, viscosity, flashpoint).

As described above, borings will extend to a minimum of 6 feet below observed sources. To evaluate the vertical distribution of Site COPCs in soil beneath sources, samples from soil borings advanced to delineate source depth will be collected for Site COPC analysis³⁵ from the following depth intervals:

- Less than 2 feet below the source; and
- 2 to 6 feet below the source.

Additional samples will be collected at 4-foot intervals to a maximum depth of 16 feet bgs, which is the assumed depth of drilling achievable using direct-push methodology. If collection of two samples beneath the source is not possible with direct-push borings, then additional drilling methods will be used to obtain at least two samples up to 6 feet beneath the source.

5.5.1.3 Source Areas Investigation

Source Areas will be defined based on the characteristics and location of the various sources identified during the Source Characterization. This section describes the objectives, logic, and process of conducting the Source Areas Investigation. Identification of Source Areas and specific exploration locations and target depths will be proposed and reviewed with EPA prior to conducting this investigation.

The objectives of the Source Areas Investigation are as follows:

- To characterize the magnitude and vertical extent of soil and groundwater contamination within and downgradient of each Source Area.
- To assess the presence of free-phase NAPL in the saturated zone and evaluate NAPL characteristics if present.

This investigation will include advancement of soil borings for characterization of subsurface lithology; collection of soil samples for laboratory analysis; and installation of monitoring wells for gauging NAPL and collecting groundwater samples for laboratory analysis. The exploration locations will include the following:

- Locations downgradient of Source Areas identified during the Source Characterization, particularly those with potentially mobile contaminants such as NAPL, to determine the lateral and vertical extent of contamination, including NAPL, in soil.
- Along groundwater flow transects, including locations along the shoreline, to evaluate potential migration of contaminants to the Port Washington Narrows and to identify appropriate locations and construction details for the installation of groundwater monitoring wells.

³⁵ Selection of soil samples within a targeted depth interval is described in Appendix A.

The Upland SQAPP (Appendix A) provides the sampling and analysis details to meet these objectives, including soil classification, field screening, and soil and groundwater sample collection. The process for conducting the investigation, including decision criteria for identifying exploration locations and details, is described below.

5.5.1.3.1 Source Areas Investigation Process

Source Area explorations will proceed in the following sequence:

- Completing a transect of deep borings oriented perpendicular to groundwater flow immediately downgradient³⁶ of each Source Area, to determine the lateral and vertical extent of soil contamination and identify appropriate monitoring well locations.
- Completing one or more wells along each transect based on boring results.
- Completing one or more wells within each Source Area.

The location and depth of deep borings in the transect will be determined following the decision logic described in Appendix A. Approximately four borings will be advanced per transect; however, the exact number of borings will depend on the size of the Source Area and the proximity of adjacent Source Area transects.

These borings will be advanced using Sonic drilling technology, which enables collection of continuous core for lithologic description and field screening and has the highest likelihood of reaching intended depths. At least one soil sample will be collected from these borings from each of the following units: fill material, native soils in the vadose zone, and each saturated unit and aquitard encountered during the boring. Each sample will be analyzed for all Site COPCs except dioxins/furans. Samples for potential dioxin/furan analysis will be archived, and archives samples will be analyzed for dioxins/furans if PCBs, chlorinated phenols, or chlorinated pesticides are detected.

At least one monitoring well will be constructed based on field screening and analytical data³⁷. The monitoring well will target the area of highest contamination observed along each transect. If contamination is detected in soil or through field observations in more than one hydrogeologic unit, an additional well will be installed in each potentially impacted unit.

After the installation and development of new monitoring wells, and redevelopment and evaluation of existing wells to ensure that they are of satisfactory integrity for use, groundwater samples will be collected for chemical analysis to evaluate the lateral and vertical distribution of Site COPCs³⁸ in groundwater from all existing and viable wells,

³⁶ It is assumed that the downgradient flow direction is north, toward the Port Washington Narrows. This assumption will be re-evaluated during early hydrogeologic characterization (see Section 5.5.1.4).

³⁷ Work will be scheduled and sequenced to minimize downtime between borings and well installation. Borings for each Source Area transect will be completed first. Drill rigs to install monitoring wells will be scheduled in advance to coincide shortly after receipt of analytical data. Pre-validated data will generally be considered adequate for decision making. Analysis of lab results may be expedited if needed to prevent significant delays to field activities.

³⁸ Except groundwater samples will be archived and analyzed for dioxins/furans only if PCBs, chlorinated phenols, or chlorinated pesticides are detected in the sample.

including those installed previously by others. Groundwater samples will also be analyzed for conventional and geochemical parameters³⁹. At the time of sampling, all new and existing viable wells will be evaluated for the potential presence of NAPL. If NAPL is observed, the thickness of NAPL will be measured. If sufficient NAPL volume is present to collect a NAPL sample, a sample from each well containing NAPL will be collected and analyzed for petrophysical parameters.

5.5.1.4 Outside Source Areas Investigation

The investigation activities to be conducted as part of the Outside Source Areas Characterization are those primarily intended to characterize the physical site environment to support development of the conceptual site model (i.e., to define the characteristics of soil and groundwater to support fate and transport evaluations), to bound extent of contamination and identify Site boundaries, and to complete the risk assessment.

Specific objectives of the Outside Source Areas Investigation are as follows:

- Evaluate the characteristics of native soil;
- Identify and characterize water-bearing zones and aquitards;
- Conduct a preliminary evaluation of groundwater flow direction to support well placement;
- Characterize shallow soil conditions to bound Site contamination and support the risk assessment; and
- Characterize groundwater quality cross-and up-gradient of source areas to define the lateral extent of Site COPCs in groundwater.

Some of these objectives may be met through the collection of data or information during the Source Characterization (Section 5.5.1.2) and the Source Areas Investigation (Section 5.5.1.3). For example, samples of fill material and native soil will be collected from borings advanced as part of the Source Areas Investigation.

The Outside Source Areas Investigation will be conducted after the Source Areas Investigation is complete and Source Areas have been defined. However, preliminary deep borings outside the area where Source Areas are anticipated will be completed prior to the Source Areas Investigation to provide a preliminary aid to that investigation.

The Outside Source Areas Investigation will include the following components:

- Preliminary deep soil borings and wells to evaluate Site physical characteristics.
- Soil sampling using Incremental Sampling Methodology (ISM) to evaluate the nature and extent of soil contamination outside Source Areas.
- Perimeter well installation to characterize the nature and extent of groundwater contamination outside Source Areas.

These components are described below.

³⁹ Conventional and geochemical parameters include dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, ferrous iron, dissolved manganese, alkalinity, pH, dissolved oxygen, oxidation-reduction potential, and other major ions (sodium, potassium, chloride, calcium, magnesium).

5.5.1.4.1 Preliminary Deep Borings and Wells

This work will consist of completing approximately three deep borings to evaluate and physically characterize Site lithology, including distinct geologic units, water-bearing zones and aquitards. The total depth of the borings will be dependent on observed geologic and hydrogeologic conditions at the time of drilling; the rationale for the total depth of the preliminary deep borings is presented in detail in Appendix A. Borings will be advanced using Sonic drilling methods to collect continuous soil samples for lithology and achieve target depths. Soil samples from each distinct lithologic unit will be analyzed for soil physical and conventional properties, including grain size, total organic carbon, and Atterberg limits. Soil density will be determined using SPT.

These borings will be completed as wells either deeper in the water table aquifer or in an underlying aquifer following the decision steps in Appendix A. The purpose of these wells is to characterize hydrogeologic characteristics of deeper groundwater. A tidal study will be conducted using existing shallow wells and the new deep wells to provide a preliminary estimate of groundwater flow direction and gradients. This work will be done prior to the Source Areas Investigation, as the data will be used to help determine the location and completion details of Source Area borings and wells. Salinity will be measured at these wells as part of evaluation of hydrogeologic conditions, but these wells will not be sampled for Site COPCs unless determined appropriate later in the investigation process.

5.5.1.4.2 Shallow Soil Characterization

Shallow soils outside Source Areas will be characterized using incremental-sampling methodology (ISM). ISM is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation (ITRC, 2012). ISM may provide a reasonable approach to collect the data necessary to calculate mean contaminant concentrations to assess risks to human and ecological receptors in shallow soil. In ISM, the area to be characterized is divided into distinct Decision Units based on historical operations, expected types or magnitudes of contamination, and/or potential exposure scenarios. ISM is generally not appropriate to characterize areas containing sources. Because of the large density of sampling points, ISM may also have limited applicability in areas with significant utility constraints, such as street rights-of-way. Decision Units will be determined based on the results of the Source Characterization and Source Areas Investigation. The application and appropriateness of ISM at the Site, including its ability to meet investigation objectives, may be reassessed after initial investigations are completed.

Details of ISM sampling are described in Appendix A. ISM sampling will include sampling of two depth intervals: 1) surface soil (0 to 3-foot depth); and 2) shallow subsurface (3- to 6-foot depth) soil. These intervals are based on consideration of human health and ecological exposure pathways for the risk assessment. The ISM process involves the following:

- Collecting a large number of soil samples from each Decision Unit and depth interval spatially distributed across the Decision Unit. For this Work Plan, three triplicates of 30 samples per Decision Unit and depth horizon (i.e., 180 samples per Decision Unit) are assumed.

- Compositing each set of 30 samples and analyzing each composite sample for all Site COPCs except VOCs⁴⁰ and dioxin/furans⁴¹ (i.e., 6 samples per Decision Unit).

ISM results in the outermost Decision Units (i.e., at the ISA boundary) will be compared to PRGs. If PRGs are exceeded, step-out Decision Units may be identified based on the results, or an alternative sampling plan to bound the extent of contamination in Site soil (i.e., discrete sampling at soil borings) may be identified.

5.5.1.4.3 Cross- and Up-Gradient Groundwater Quality Characterization.

Monitoring wells will be installed to provide groundwater quality data in cross- and up-gradient locations from the Source Areas and to define the Site boundary. Wells will be developed and sampled for all Site COPCs⁴² and for dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, ferrous iron, dissolved manganese, alkalinity, pH, dissolved oxygen, oxidation-reduction potential, and other major ions (sodium, potassium, chloride, calcium, magnesium) to characterize Site geochemical conditions.

5.5.1.5 Groundwater Testing and Monitoring

After Site boundaries are identified, a groundwater testing and monitoring program will be implemented to more fully characterize groundwater conditions. The testing and monitoring program will include:

- Slug testing at selected monitoring wells to measure hydraulic conductivity of each water-bearing zone.
- A tidal study using pressure transducers in Site wells to measure groundwater gradients, and tidal influences.
- Quarterly measurement of groundwater conventional and geochemical parameters, including dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, ferrous iron, dissolved manganese, alkalinity, pH, dissolved oxygen, oxidation-reduction potential, and other major ions (sodium, potassium, chloride, calcium, magnesium) to evaluate conditions for biological and chemical degradation of contaminants.
- Quarterly measurement of selected Site COPCs for a minimum of one year, to assess seasonal trends.

Wells for hydraulic testing will be determined after the Site boundaries and the number of affected water-bearing zones have been determined.

As described in previous sections, wells will be tested initially for Site COPCs and conventional/geochemical parameters. Specific wells and analyses for quarterly groundwater monitoring will be determined based on initial testing results. Locations and

⁴⁰ Samples for VOC analysis should not be composited. One discrete VOC sample from each depth horizon will be collected for every 250 square feet of Decision Unit area.

⁴¹ Except soil samples will be archived and analyzed for dioxins/furans only if PCBs, chlorinated phenols, or chlorinated pesticides are detected in the sample.

⁴² Except for dioxins/furans.

frequency for groundwater monitoring after one year, to evaluate long-term trends, will be determined based on the first years' worth of data.

5.5.2 Marine Investigation

The marine investigation elements described in this Section address data gaps identified in the RI/FS scoping process. The locations of each data acquisition point/location have been determined in consultation with EPA. However, each of the proposed locations is subject to revision based on conditions encountered in the field at the time of data acquisition.

The sequence of the investigation elements is integrated into this Work Plan to inform PRG development, COPC identification, risk assessment, and the definition of the nature and extent of contamination. Sediments will be analyzed for Site COPCs (VOCs, SVOCs, cyanide, metals, PCBs, pesticides, and dioxins/furans), including tiered approaches for VOCs, PCB congeners, and dioxin/furans as described in the Marine SQAPP (Appendix B, Section 3.1.3). Surface water samples will be analyzed for all Site COPCs, except for dioxins/furans. All surface sediments within the ISA, surface water, and SPME porewaters will be analyzed for alkylated PAHs. Alkylated PAH results may be useful for differentiating between potential PAH sources. Statistical analysis of PAH parent and alkyl homologs results will be conducted to determine if or where populations are differentiated. Only the 16 parent PAH compounds are considered Site COPCs and alkyl homologs results are used for forensic purposes only. The elements of the marine investigation are summarized in Table 5-16.

The initial data acquisition program will include the following:

- **Video Surveys.** Video surveys will be conducted to identify substrate, habitat characteristics, and presence of aquatic resources near the Site. This information will be used to evaluate the presence of anthropogenic structures or features that require consideration during the RI/FS (Figure 5-5).
- **Tidal Current Evaluation.** Near-bottom and mid-depth tidal currents within the aquatic areas of the Site will be monitored to assist in the evaluation of sediment stability and sediment transport processes (using sediment grain size testing results)
- **Surface Sediment Investigation.** Surface sediments will be sampled and analyzed as follows:
 - a. Within the marine environment immediately adjacent and to the north of the Former Gas Works Property, 19 surface samples will be collected and analyzed for Site COPCs (ISA-101 to ISA-119; Figure 5-6).
 - b. Within the ISA, 14 surface samples will be collected and analyzed for Site COPCs (ISA-01 to ISA-14; Figure 5-7).
 - c. Outside of the ISA, additional data will be acquired at 16 stations to assess the physical characteristics of sediment within the Port Washington Narrows (PWN-01 to PWN-16; Figure 5-8). These data will be used to evaluate sediment transport processes within the Port Washington Narrows.
 - d. At 5 intertidal locations with the ISA, paired samples of bulk sediment and porewater will be analyzed to evaluate Site PAH as compared to literature-derived partitioning coefficients (ISA-113 to ISA-117; Figure 5-6).

- **Baseline Shellfish Habitat Surveys.** Beach surveys will be performed to identify the presence of aquatic and shellfish resources within and near the beach areas adjacent to the Former Gas Works Property at 7 locations (ISA-08, ISA-113 to ISA-117, and PWN-14; Figure 5-6 and Figure 5-7). These habitat surveys will provide information on existing habitat conditions. The findings of the surveys are not intended to restrict shellfish consumption rate estimates used in the Human Health Risk Assessment.
- **Subsurface Sediment Investigation.** Subsurface sediment core samples will be collected from 19 beach and subtidal areas sloping down into the Port Washington Narrows and in the adjacent marina to evaluate the vertical distribution of chemicals, including the potential presence of NAPL and hydrocarbon sheen, in subsurface sediments (ISA-101 to ISA-119; Figure 5-6).
- **Surface Water Investigation.** Surface water samples from 4 selected Site and background locations (ISA-101, ISA-106, PWN-07 and PWN-11) will be collected and analyzed during multiple sampling events to assess potential variability in the concentrations of contaminants in surface water (Figure 5-6 and Figure 5-8). The surface water analysis will include a full suite of conventional and Site COPC testing.

The general rationale and approach for these components of the marine investigation are described in the following Sections, and the details are included in Appendix B. Based on the results of the marine investigation, contingent investigations or studies may be warranted; those are described in Section 5.6.

5.5.2.1 Video Survey

The objective of the towed camera surveys is to qualitatively identify general substrate types (e.g., grain size assessment if visible), general habitat characteristics (e.g., rocky or vegetated surface), the presence of aquatic resources (e.g., fish or eel grass), and identify any unknown anthropogenic features (e.g., outfalls, structures, or sunken barges). The video surveys will be collected along 12 predefined transects in the Port Washington Narrows in the vicinity of the ISA (Figure 5-5). Six transects each will be conducted perpendicular to and parallel with the shoreline of the Port Washington Narrows. The parallel video transects are positioned at the southern and northern shores at the -10 feet mean lower low water (MLLW) and -20 feet MLLW contours (Figure 5-5), through the deeper channel area adjacent to the former gas works, and over the shallower area in the central channel. One of the perpendicular transects is positioned through the slope adjacent to the former gas works and two are positioned to the east and west in the Port Washington Narrows. After the video surveys are complete, the locations of the transects will be plotted on a figure. The videos will be reviewed to qualitatively determine, at a minimum, the substrate type, habitat characteristics, presence of aquatic resources, and any other significant observations, and the results will be logged. This survey will yield an interpretative figure that presents the video survey findings. The results will be used to determine habitat types and identify anthropogenic structures or natural features or resources that merit consideration as part of the RI/FS process.

5.5.2.2 Tidal Current Evaluation

Tidal current surveys will be conducted by a qualified contractor along four transects at the locations shown on Figure 5-5. A vessel-mounted acoustic Doppler current profiler will be used to measure current velocity along transects over the course of a daily tide

cycle with a relatively high tidal exchange. Sampling will be performed during a period of high tidal exchange (between a high tide of at least mean higher high water and a low tide below MLLW). Measurements will be collected in both directions (i.e., back and forth) across each transect location to decrease any directional bias in the data. Results from near-bottom measurements within the ISA will be used to inform the FS and assess the potential impacts of tidal currents on sediment stability.

5.5.2.3 Beach Shellfish Surveys

Beach shellfish surveys will be conducted to document the presence of aquatic resources within and immediately adjacent to the ISA. The surveys will be conducted at seven locations within and adjacent to the ISA and (Figure 5-6 and Figure 5-7) in accordance with WDFW methods (Appendix B; Campbell, 1996). These surveys will provide information on existing habitat conditions. The findings of the surveys are not intended to restrict shellfish consumption rate estimates used in the Human Health Risk Assessment.

5.5.2.4 Surface Sediment Investigation

Surface sediment samples will be collected to characterize the lateral nature and extent of contamination, evaluate chemical fate and transport, determine Site COPCs, evaluate relative bioavailability of PAHs, and quantify sediment transport processes. All surface sediment samples will be collected from a depth 0 to 4 inches below the mudline that typically constitutes the bioactive zone. Consistent with previous Site-related investigations, ISA intertidal sediment samples will be collected by hand during low tide, and will be composed of a localized station composite of five equal volume aliquots collected from within approximately 6 feet of the target coordinate (Anchor QEA 2013). All subtidal surface sediment samples and intertidal samples outside the ISA will be collected using a power actuated Van Veen grab sampler. The surface sediment samples submitted for differing testing suites are described as follows:

- To characterize the lateral nature and extent of contamination, and evaluate chemical fate and transport, 19 surface sediment samples will be collected and analyzed, for Site COPCs, immediately adjacent and to the north of the former gas works (ISA-101 to ISA-119; Figure 5-6).
- To determine the relative bioavailability of PAHs, five intertidal locations will be tested by ex situ SPME methodology (Figure 5-6). The methodology includes bulk sediment collection, insertion into the sediments of performance reference compound-spiked SPME fibers, equilibration period, post-equilibration SPME chemical analysis, and data evaluation to derive estimated porewater concentrations. Paired with bulk surface sediment results, these data will be used to evaluate bioavailability relative to literature-based values. Ex situ testing methodology is further detailed in Appendix B.
- To define the lateral extent of contamination in sediments within the ISA, 16 additional surface sediment locations will be collected (Figure 5-8). These samples will be analyzed for Site COPCs as detailed in Appendix B.
- Surface sediment locations within the ISA (33 stations) will be tested for alkylated PAHs. Alkylated PAH results may be useful for differentiating between potential PAH sources. Statistical analysis of PAH parent and alkyl homologs results will

be conducted to determine if or where populations are differentiated. Only the 16 parent PAH compounds are considered Site COPCs and alkyl homologs results are used for forensic purposes only.

- To evaluate sediment transport processes, 16 samples outside the ISA (PWN-01 to PWN-16) but within intertidal and subtidal bedded sediment will undergo physical testing. Physical testing coupled with current velocities and modeled wind and wave action will identify conditions that mobilize and redistribute sediment.

Nineteen surface sediment sampling locations immediately adjacent to the former gas works, within the marine portion of the ISA, were selected in consultation with EPA (Figure 5-6). Seventeen of those sampling locations are arrayed in transects downslope toward the Port Washington Narrows channel. Within the marina to the west of the slope, two additional sampling locations were placed to evaluate sediment quality where historical dredging has been conducted. These 19 sampling locations are collocated with subsurface cores collection locations for vertical delineation of the nature and extent of contamination (see 5.5.2.5).

Fourteen additional surface sediment locations will be sampled to characterize the lateral nature and extent of contamination in areas of the ISA further offshore of the former gas works (ISA-01 to ISA-14; Figure 5-7). For representative spatial coverage emanating from the former gas works, a sample will be collected from the western extent of the marina, from two intertidal locations in the eastern extent of the ISA, from four subtidal locations immediately offshore of the base of the slope, and from seven subtidal locations distributed throughout the ISA.

Sixteen surface sediment locations outside the ISA will be submitted for physical testing to inform evaluations of sediment transport processes (coupled with ADCP results and modeled wind and wave conditions) within Port Washington Narrows (Figure 5-8). The sediment transport in intertidal areas (through littoral drift) and bedded sediments (channel sediment stations) will be evaluated. Of the 16 locations, 11 target the littoral drift zones and five characterize bedded sediments in the channel of Port Washington Narrows.

The results of all aspects of the surface sediment investigation will be presented in the Phase 1 Data Report.

5.5.2.5 Subsurface Sediment Investigation

Subsurface core sampling will be conducted to determine the vertical nature and extent of Site COPCs (including NAPL and sheen). The subsurface explorations will be advanced at 19 sampling locations along transects aligned down the slope from the Former Gas Works Property and at two locations immediately west of the slope within the marina, all of which are at the same locations as the surface sediment sampling locations (Figure 5-6). The subsurface sampling area includes the intertidal areas where with Site COPCs are known to be elevated and in locations of historical dock structures. As designed, the core sampling program is of sufficient density to evaluate migration pathways to characterize all potential directions of travel as described in Section 4.2.1. To evaluate potential release pathways to the Port Washington Narrows, the deepest core in each transect targets the -20 feet MLLW elevation to acquire subsurface sediments below the approximate elevation of the channel depth of -25 feet MLLW.

At each location, a 15-foot-long vibracore will be advanced until it can penetrate no further. Each core will be logged and sectioned into approximately 1- to 2-foot intervals (no interval will be greater than 2 feet), unless otherwise indicated based on visual observation and stratigraphy, for testing. Because surface sediment quality will have already been characterized (cores are collocated with surface samples), only two subsurface intervals per core will initially be submitted for physical and chemical testing. The core intervals targeted for analysis will be based on field screening, and will include one sample (the ‘midpoint core interval’) exhibiting significant potential for contamination (if observed) and one sample interval below the potentially contaminated sample interval (the ‘lower core interval’) where no visible indication of potential contamination is observed. The surface, midpoint, and lower core interval data will be used to quantify the vertical extent of contamination and inform contaminated sediment volume evaluations in the FS. All remaining core intervals will be archived for future analysis, if needed.

If NAPL or another obvious form of contamination is identified during the processing of subsurface cores collected at any perimeter subsurface core locations (Appendix B), an additional core will be collected offset from the initial location. If necessary, the exact placement will be made by the Field Coordinator (identified in Appendix B) and reported to EPA.

The planned subsurface investigation will be completed using vibracore exploration methods. To the extent that the findings of upland and sediment investigations indicate that Site-related contamination is likely to be present in sediment strata that could not be evaluated using these sampling methods, other sampling approaches will be considered. If alternative methods (e.g., use of barge-mounted auger drilling methods) are warranted, the methods and locations for such follow-up investigations would be defined in an addendum to this Work Plan (see Section 6.2).

5.5.2.6 Surface Water Investigation

Surface water samples will be collected from two locations within the ISA (ISA-101 and ISA-106; Figure 5-6) and at two background locations (PWN-07 and PWN-11; Figure 5-8) for testing of physical properties and chemical analysis. These data will be used to inform the HHRA and ERA. To assess potential variability associated with seasons and weather conditions, four quarterly sampling events will be conducted. One of the sampling events will target a rain event, and another will target a relatively dry period. At each location, samples will be collected from 3 feet below the water surface and 3 feet above the mudline. The surface water samples will be submitted for an analysis of Site COPCs, conventional parameters, and alkylated PAHs. Field measurements of dissolved oxygen, pH, salinity, and temperature will be recorded at each sampling depth.

5.5.2.7 Marine Tissue Investigation

The scope and methodology for collection and analysis of marine tissue samples to support the HHRA and possibly the ERA will be documented in the Risk Assessment Technical Memorandum (Section 5.3.1).

5.6 Contingent Studies

Other studies in addition to those described in Section 5.5 may be necessary to characterize the Site for the RI/FS. However, the need and scope of these studies will

depend on the results of the initial studies. Potential contingent studies are described below.

5.6.1 Upland Investigation

Contingent upland investigation activities may be warranted to fill remaining data gaps after completion of the work described in Section 5.5.1. These contingent investigation tasks may include the following:

- Additional investigation into the nature of NAPL, if free-phase NAPL is identified, by applicable petrophysical testing methods;
- Additional investigation into the extent of NAPL by applicable *in-situ* and/or *ex-situ* characterization techniques;
- Sampling of soil vapor and/or indoor air, if the soil and/or groundwater data indicate a potential risk to existing occupied⁴³ or future structures;
- Evaluation of the groundwater-to-surface water pathway; and
- Development of hydraulic and/or contaminant fate-and-transport groundwater models.

The scope of and methods for these studies, if needed, will depend on the results of the initial investigations and are, therefore, not provided in this Work Plan. An addendum to this Work Plan would be prepared if additional studies are needed. A brief description of potential contingent activities is provided below.

If NAPL is present at sufficient volumes in any wells, bail-down tests may be used to estimate the transmissivity of DNAPL and LNAPL. Other petrophysical testing methods may also be applicable, depending on the type, quantity, and location of NAPL identified during the RI.

The TarGOST® technology, which uses laser-induced fluorescence to delineate manufactured gas plant tar or creosote NAPL (moderate to heavy concentration of PAHs), could possibly be used to detect and characterize NAPL in fill and shallow native soils in areas where manufactured gas plant tar or creosote has been identified by other investigation methods. However, TarGOST® is specifically intended for use in delineating NAPL-contaminated zones and is appropriate for sites where there is a confirmed presence of manufactured gas plant tar or creosote NAPL. In addition, TarGOST® is conducted using direct-push drilling methods that likely have limited depth penetration capabilities at the Site due to the dense glacial soils. A preliminary understanding of the extent to which NAPL is present in shallow or deeper soils at the Site, and a better understanding of the nature of subsurface soils at the Site is needed to determine whether the use of TarGOST® could be successful at the Site.

Ultraviolet (UV) light photography could be used to characterize NAPL occurrence and extent with low to moderate concentrations of PAH components. The technique uses a digital image of a soil core in an area of known or suspected NAPL to evaluate the nature of the NAPL, such as its pore space saturation and its potential mobility. UV light

⁴³ Existing structures within the ISA include two warehouse buildings used for storage of automotive parts and equipment. Ongoing use and occupancy of these structures will be further evaluated during the RI to determine if additional assessment of indoor air is warranted.

photography can also determine the relative impacts within a single core to identify the most heavily impacted zone and identify variation in NAPL impacts between soil lithologies within the core.

After the extent of contamination in soil, groundwater, sediment, and surface water is better defined, ongoing transport of contaminants to surface water/sediment will be evaluated. This may include assessment of the continuity of contamination from the upland to marine areas through groundwater and sediment porewater sampling, including depth profiles of contamination in porewater; delineation of NAPL at the shoreline; and estimates of contaminant flux in groundwater.

Hydraulic and/or contaminant transport groundwater models may be useful tools for conducting the RI and FS. These tools can be used in conjunction with empirical data to further the understanding of contaminant fate and transport and support the engineering evaluations of remedial technologies such as groundwater pumping. However, additional Site information is needed to evaluate the usefulness of these tools and which models might be appropriate.

As discussed in Sections 6.1 and 6.2, any contingent work activities will be proposed based on the data gaps identified in the Phase 1 Data Report. The scope of work and sampling methodology for the contingent upland investigation would be described in detail in an addendum to this Work Plan (Section 6.2), which would be approved by EPA before the completion of any additional work.

5.6.2 Marine Investigation

Contingent sediment investigation activities may be warranted to fill remaining data gaps after completion of the work described in Section 5.5.2. These contingent investigation tasks may include the following:

- Potential step-out surface or subsurface sampling in the sediment areas of the Site, if needed to define the nature and extent of Site-related contamination.
- Supplemental subsurface sediment coring using alternative methods, if needed, to evaluate the distribution of Site-related contamination not accessible using vibracore methods.
- Sediment bioassay and/or porewater testing, if necessary to confirm the estimated extent of benthic infaunal community impacts for the ERA.
- Additional testing of Site-related contaminant concentrations in tissues in relevant seafood species or prey species where necessary to support the HHRA or ERA.
- Sediment geochronology testing, if it is determined necessary to support the evaluation of sediment stability and natural recovery processes.

The scope of and methods for these studies, if needed, will depend on the results of the initial investigations and are, therefore, not provided in this Work Plan. An addendum to this Work Plan would be prepared if additional studies are needed (see Section 6.2).

6 Remedial Investigation Tasks

This Section provides a general description of the tasks to be performed to complete the RI in accordance with the AOC, the SOW and EPA RI/FS guidance (EPA 1988a). It also summarizes the various phases of work and how each phase relates to the next phase. A flowchart showing the sequence of the remedial investigation and risk assessment components is provided on Figure 1-2. A general schedule for completion of the work including key decision points is provided in Section 8. Specific details of field investigation methods and sampling approaches, as currently planned, are provided in Appendix A.

6.1 Planned Remedial Investigation Activities

The planned work activities, as described in Section 5.5, will be completed to meet the objectives of the RI/FS in accordance with the requirements of the SOW. The collection of data will address the data needs to assess the current and future potential risk to human health and the environment and allow for the development and screening of remedial action alternatives. The planned work activities, presented herein, are those anticipated to be necessary to meet the RI/FS objectives, which are further specified in the SOW:

- Investigate and define the physical, chemical, and biological characteristics of the Site;
- Define the sources of contamination;
- Define the human and ecological uses of Site; and
- Describe the nature and extent of contamination.

Field and preliminary laboratory data will be provided to EPA as it is received, following the field communication plans in Appendices A and B, to enable adaptive management practices in evaluating whether the RI/FS objectives have been met. Data may also be summarized in tabular or visual form as needed to support work planning. Some specifics of the field investigation, such as the number, location, and depth of step-out trenches, borings and wells, will be determined during the investigation following the decision-making criteria outlined in this Work Plan. Proposed and completed field activities will also be communicated in accordance with the field communication plans to enable ongoing review and input from the Cascade and EPA project teams.

After the completion of the work activities described in this Work Plan, the Phase 1 Data Report will be prepared to compile the collected data. In accordance with the SOW, the Phase 1 Data Report will describe and display information and data collected during the Site characterization activities, including the sampling locations and the distribution of contaminant concentrations. If data needs are identified that require activities not covered by this Work Plan, one or more addenda to this Work Plan may be prepared (see Section 6.2).

6.2 Contingent Remedial Investigation Activities

If determined to be necessary to satisfy outstanding data needs and meet the objectives of the RI/FS, contingent studies will be proposed in one or more addenda to this Work Plan. The contingent studies may consist of the expansion of previous studies, potential

contingent studies identified in Section 5.6, or other studies that are warranted based on the collected data. Addenda to this Work Plan, if applicable, may be submitted with the Phase 1 Data Report. Each addendum to this Work Plan will present the proposed scope of work, including the basis for the additional work and the rationale for the sampling locations and/or methodology.

Data collected during contingent studies will be documented and submitted to EPA in the Phase 2 Data Report.

6.3 Risk Assessment

The RI/FS will include collection of information and data necessary to perform a baseline HHRA and ERA, in accordance with the SOW (EPA, 2013a). The risk assessment strategy will be developed in consultation with EPA and the Tribe. The risk assessment will consider current and potential future land uses at the Site, considering local land use designations applicable to the Former Gas Works Property and the Sesko Property. A Risk Assessment Technical Memorandum will be prepared in conjunction with the Phase 1 Data Report to present the preliminary screening of the RI data and provide a detailed description of the methods to be used for the baseline risk assessments. The Risk Assessment Technical Memorandum will evaluate the data presented in the Phase 1 Data Report. The Risk Assessment Technical Memorandum will be submitted to EPA for concurrence that sufficient data has been collected, or to propose the collection of additional data, to enable preparation of the draft baseline HHRA and ERA. The scope and key elements of the HHRA and ERA are described in Section 5.3.

The draft reports for the baseline HHRA and ERA will be submitted to EPA as part of the Draft RI Report (Section 6.4). After EPA has reviewed the Draft RI Report and provided comments, the final risk assessment reports will be submitted to EPA with the Final RI Report (Section 6.4).

6.4 Remedial Investigation Report

After the completion of any contingent studies and EPA approval of the data report summarizing the final phase of investigation (either the Phase 1 Data Report or a Phase 2 Data Report), a Draft RI Report will be prepared to summarize the results of all phases of the field activities conducted to characterize the contaminant sources, evaluate the nature and extent of contamination, and evaluate the fate and transport of contaminants. The Draft RI Report will be submitted to EPA for review in accordance with the requirements of the AOC. After the receipt of EPA comments, a Final RI Report will be prepared.

7 Feasibility Study Planning

Section 7 describes tasks involved in developing the FS, particularly the review of remedial approaches, including potentially applicable remedial technologies, based on similar sites. Further development of the CSM is necessary before identifying remedial approaches for the Site. A preliminary review of the remedial technologies helps determine what data may need to be collected during the field investigations discussed in Section 5.

7.1 Feasibility Study Tasks

This Section describes the tasks that will be conducted to identify potential remedial approaches and select a remedy for the Site in accordance with the AOC, the SOW, and EPA RI/FS guidance (EPA 1988a). This Section also summarizes each phase of the FS and how each phase relates to the next one. A tentative schedule for completion of the FS is provided in Section 8.

7.1.1 Remedial Alternatives Development/Screening

The first step in the FS process will be the preparation of an Alternatives Development Memorandum that identifies and screens a range of potential remedial alternatives to determine whether they should be included in a more detailed analysis. The Alternatives Development Memorandum will include the following:

- Identification of refined RAOs based on the results of the RI and baseline risk assessments;
- Development of general, potential response actions for each medium of interest to meet the RAOs;
- Identification of areas and volumes of Site COPCs to which the general response actions may apply;
- Identification and evaluation of remedial technologies applicable to each general response action and a screening to determine and document those that will be eliminated from further evaluation;
- A presentation of the selected remedial technologies and their assembly into remedial action alternatives for the Site;
- A summary of the action-specific and contaminant-specific ARARs and PRGs for each of the assembled remedial action alternatives;
- A screening of the assembled remedial action alternatives based on short- and long-term effectiveness, implementability, and relative cost, if necessary.

The Alternatives Development Memorandum will be prepared after EPA approval of the Final RI Report.

7.1.2 Treatability Study/Pilot Testing

Treatability studies and/or pilot testing of potential remedial technologies will be performed after the preparation of the Alternatives Development Memorandum, if necessary to support further evaluation of the retained alternatives. If treatability studies or pilot testing are determined to be necessary to evaluate a technology, a Treatability Testing Work Plan will be prepared to describe the technology, present the purpose of the treatability study/pilot testing, and summarize the testing approach and methodology, including a Sampling and Analysis Plan, if appropriate. The results of the treatability study/pilot testing will be summarized in a Treatability Study Evaluation Report, which will be submitted to EPA as a draft for review and comment; any comments provided by EPA will be addressed in a final version of the report.

7.1.3 Detailed Analysis of Alternatives

A detailed analysis of the final set of alternatives (Section 7.1.1) and the results of any treatability studies and/or pilot testing (Section 7.1.2) will be performed. It will consist of an analysis of each alternative in terms of nine CERCLA evaluation criteria (EPA 1998a) and a comparative analysis of all the alternatives using the same criteria as a basis for comparison. The results will be documented in an Alternatives Evaluation Memorandum.

7.1.4 Feasibility Study Report

After the receipt of EPA comments on the Alternatives Evaluation Memorandum, the Draft FS Report will be prepared to present the basis for remedy selection and document the development and analysis of the remedial alternatives. The Draft FS Report will be submitted to EPA for review in accordance with the requirements of the AOC. After the receipt of EPA comments, a Final FS Report will be prepared.

7.2 Potential Remedial Approaches

This Section describes potentially applicable remedial technologies and approaches based on similar sites. The purpose of this description is to provide an initial understanding of what remedial technologies may be applied and identify data required to evaluate the feasibility of each technology to meet the RAOs. The selected remedy is typically a combination of multiple remedial technologies to achieve all RAOs.

7.2.1 Potential Remedial Technologies

Achieving RAOs at a site typically occurs by implementing a combination of several remedial technologies. Depending on site-specific circumstances, the selected remedial technologies may result in the complete elimination or destruction of hazardous substances at the site, the reduction of hazardous substances at the site, the reduction or elimination of migrating hazardous substances at the site, or some combination of these effects. Remedial technologies may be used in combination with engineering controls (e.g., barriers such as fences or caps) or institutional controls (i.e., non-engineered controls such as land use restrictions) when hazardous wastes remain at a site. The National Contingency Plan states a preference for remedial technologies at Superfund sites that involve treatment, including but not limited to controlling or eliminating sources and reducing or eliminating exposure pathways, particularly for highly contaminated materials.

Remedial technologies are often categorized by the following general response actions, which are applicable to both upland and marine environments:

- **Monitored Natural Attenuation.** Natural attenuation is the reduction of contaminant concentrations at the point of exposure over time by means of natural processes, such as sedimentation, sorption, dispersion, and/or biodegradation. Monitoring documents that the processes are occurring at the desired rates. For sediment, this general response action is referred to as monitored natural recovery.
- ***In Situ* Containment.** *In situ* containment involves confining hazardous substances in place by the placement of physical barriers or hydraulic controls. Containment technologies can be designed to prevent contact with and/or migration of hazardous substances.
- ***In Situ* Treatment.** *In situ* treatment technologies can potentially reduce the concentration, mobility, and/or toxicity of COCs.
- **Removal.** Contaminated materials can be physically removed from a site and treated and/or disposed of at either an on-site or an off-site permitted disposal facility.
- ***Ex Situ* Treatment.** *Ex situ* treatment technologies destroy or immobilize contaminants in media that have been removed from the subsurface.
- **Disposal.** Disposal technologies include the placement of contaminated solid media in on-site or off-site landfills or the discharge of contaminated water to a publicly owned treatment works.

Preliminary lists of potential remedial technologies for NAPL, soil, groundwater, and sediment at the Site are provided in Tables 7-1 through 7-4, respectively.

7.2.2 Remedial Approaches at Other MGP Sites

Hundreds of MGP sites around the country have been through or are undergoing an RI/FS and cleanup action. Table 4-2 identifies remedial approaches that have been fully or partially implemented at MGP sites with characteristics (e.g., geology and presence of adjacent surface water bodies) that are similar to the Bremerton Gas Works Superfund Site. Common actions have included combinations of removal with off-site disposal or on-site treatment, solidification/stabilization, and institutional and engineering controls. Other technologies have included pump-and-treat, bioremediation, *in situ* chemical oxidation, barriers, and NAPL collection.

7.2.3 Feasibility Study Data Gaps

As part of the FS, the potential remedial technologies identified in Tables 7-1 through 7-4 will be evaluated based on each technology's effectiveness, ability to be implemented, cost and fit. Evaluating and analyzing each into remedial technology requires a good understanding of Site characteristics. In general, data gathered during the RI to develop the CSM (including characterizing physical characteristics of the Site, e.g., hydrogeology and groundwater flow, delineating the nature and extent of contamination, evaluating contaminant fate and transport, and assessing risks to human health and the environment) will also support the development and evaluation of remedial alternatives.

Data from characterization of the Site will need to be sufficient to develop hydraulic and contaminant fate-and-transport models that may be needed to assist in the engineering evaluations during the FS (e.g., in developing and evaluating alternatives that use groundwater extraction or dewatering). The data will also need to be sufficient to delineate the extent of contaminant source areas or "hot spots."

In addition, the following information is anticipated to be necessary to complete the FS:

- Geotechnical data (e.g., for developing excavation and shoring plans), including penetration test data, soil moisture content, Atterberg limits, and gradation;
- Recoverability characteristics of NAPLs, if present;
- Waste characteristics (e.g., toxicity characteristic leaching procedure [TCLP]) to determine potential disposal and/or treatment options; and
- Evaluations of current velocity and sediment substrate study by means of a towed video camera, to evaluate physical forces and geologic formations.

Additional technology-specific data needs may be identified as more data are collected and the FS alternatives are developed. These may include Site characterization data, bench testing, or pilot testing of potential remedial technologies.

8 Schedule

The field investigation activities described herein will commence within 30 days after receipt of EPA's written approval of this Work Plan. The estimated schedule and sequencing of field investigation activities is provided in Table 8-1. The actual schedule may vary based on several factors including contractor availability, the date EPA approves this Work Plan, and adjustments to the scope of work based on field investigation findings.

The schedule for completing RI/FS investigation activities and deliverables will be consistent with the deadlines defined in the AOC, which include the following:

- Prepare and submit the Phase 1 Data Report to EPA within 90 days after completion of Site characterization activities and receipt of final validated data. The Phase 1 Data Report will summarize the results of the Site characterization activities and identify any outstanding data needs.
- The Risk Assessment Technical Memorandum will be prepared and submitted to EPA with the Phase 1 Data Report. The Risk Assessment Technical Memorandum will present the preliminary screening of the RI data and provide a detailed description of the data required and methods to be used for the baseline risk assessments.
- If warranted by the results summarized in the Phase 1 Data Report, prepare an addendum to this Work Plan describing the additional Site characterization activities necessary to meet the objectives of the RI/FS. After EPA approval of the addendum to this Work Plan, complete the additional Site characterization activities.
- Prepare and submit a Phase 2 Data Report to EPA within 90 days after completion of the additional Site characterization activities and receipt of final validated data. The Phase 2 Data Report will summarize the results of the additional Site characterization activities.
- The Draft Baseline Ecological and Human Health Risk Assessment Reports will be prepared and submitted to EPA within 180 days after receipt of all final validated data obtained during Site characterization activities, including any contingent studies.
- The Draft RI Report will be prepared and submitted to EPA within 360 days after receipt of all final validated data obtained during Site characterization activities, including any contingent studies.
- The Final RI Report, which will include the Final Baseline Ecological and Human Health Risk Assessment Reports, will be submitted to EPA within 90 days after receipt of comments from EPA on the Draft RI Report.
- The Alternatives Development Memorandum will be submitted to EPA within 90 days after receipt of EPA's written approval of the Final RI Report.
- If necessary, a Treatability Testing Work Plan, treatability testing, and the Treatability Study Evaluation Report will be completed to further evaluate alternatives introduced in the Alternatives Development Memorandum. A separate schedule will be prepared for these activities if they are deemed necessary.

- The Alternatives Evaluation Memorandum will be submitted to EPA within 90 days after receipt of EPA's comments on the Alternatives Development Memorandum and Treatability Study Evaluation Report, if applicable.
- The Draft FS Report will be submitted to EPA within 120 days after receipt of EPA's written approval on the Alternatives Evaluation Memorandum.
- The Final FS Report will be submitted to EPA within 60 days after receipt of comments from EPA on the Draft FS Report.

9 Project Management Plan

This Section identifies key project staff and responsibilities and describes lines of communication and project coordination details. It also includes a description of data management procedures.

9.1 Project Management

The RI/FS is being conducted by Cascade. EPA is providing regulatory oversight of the RI/FS activities in accordance with the AOC. Cascade and EPA project teams are described in Section 9.1.1.

Other participating entities (i.e., stakeholders) include property owners, other regulatory agencies, and interested organizations. Key stakeholders who participate in the scoping, review, and comment on the RI/FS, and their general roles, are described in Section 9.1.2. EPA has the primary responsibility for engaging and coordinating with these key stakeholders throughout the RI/FS process and Cascade and its contractors will provide support, as needed, for these coordination efforts.

9.1.1 Project Teams

The Remedial Project Manager (RPM) for EPA is:

Eva DeMaria
EPA Region 10, Office of Environmental Cleanup (ECL-122)
1200 Sixth Avenue
Seattle, Washington 98101
Phone: (206) 553-1970
E-mail: DeMaria.Eva@epa.gov

The Project Coordinator for Cascade is:

Kalle Godel
Montana-Dakota Utilities Co.
400 North Fourth Street
Bismarck, North Dakota 58501
Phone: (701) 222-7657
E-mail: Kalle.Godel@mdu.com

The Cascade Project Coordinator is responsible for administering the actions required by the AOC.

EPA's oversight contractor for the RI/FS work is CH2M. The project manager for CH2M is Susan Moore.

Cascade's consultant project team consists of representatives from Aspect and AnchorQEA and their subconsultants and subcontractors. Aspect will be coordinate RI/FS activities for the upland area of the Site. Anchor QEA will coordinate RI/FS activities in the marine area of the Site and conduct the risk assessment. Aspect will be responsible for overall project management and production of RI/FS deliverables.

The project managers for Aspect and Anchor QEA, who have final authority and responsibility for their teams' activities, are as follows:

- **Aspect:** Jeremy Porter
- **Anchor QEA:** Mark Larsen

Supporting project team members and team management structure for conducting the Site characterization activities described in this Work Plan are provided in the Upland and Marine SQAPPs (Appendices A and B).

All work will be conducted in accordance with the consultants' Quality Management Plans, which have been previously submitted to EPA in accordance with Section VIII of the AOC.

All work conducted by Aspect and Anchor QEA will be completed in accordance with applicable state and federal worker health and safety requirements. The site-specific Health and Safety Plans for each organization, which establishes the procedures and practices to protect their workers from potential hazards posed by field activities at the Site, are included as Appendices G (Aspect) and H (Anchor QEA).

9.1.2 Stakeholders

Key stakeholders and their general roles are as follows:

- The Suquamish Tribe: As described in Section 2.2, the Site and vicinity are in the traditional territory of the Tribe. Under the 1855 Treaty of Point Elliott, the Tribe retained "the right of taking fish at usual and accustomed grounds and stations," which include the Port Washington Narrows. EPA will consult with the Tribe throughout the RI/FS regarding issues of potential interest to the Tribe including matters affecting fish and wildlife or potential cultural or archaeological resources.
- Owners of Property Within the ISA:
 - McConkey Family Trust (owner of the McConkey Property);
 - Penn Plaza Storage LLC (owner of the Penn Plaza Property);
 - Natasha Sesko (owner of the Sesko Property);
 - DNR (owner of aquatic tidelands); and
 - City of Bremerton (owner of public rights-of-way).
- Regulatory and Resource Agencies with jurisdiction at the Site:
 - Kitsap Department of Health (KDOH): A local agency that manages numerous local regulations and programs targeted at human health protection. KDOH has been working with other agencies and stakeholders to improve water and shellfish quality within Port Washington Narrows and Dyes Inlet.
 - Ecology: A state agency responsible for implementing numerous state regulations addressing soil, groundwater and surface water quality, including but not limited to the Model Toxics Control Act (MTCA; WAC

Chapter 173-340), the Sediment Management Standards (SMS; WAC Chapter 173-204) and Washington's Water Quality Standards (WAC 173-201a).

- WDFW: A state agency responsible for implementing Washington State regulations and programs related to protection, enhancement and harvesting of wildlife, fish and shellfish resources.
- WDOH: A state agency responsible for regulations and programs targeted at human health protection, including but not limited to the management of fish and shellfish consumption advisories. The WDOH has also conducted a preliminary health screening of the Site (WDOH 2014).
- NOAA and the United States Fish and Wildlife Service: Federal agencies responsible for implementing Federal regulations and programs related to protection, enhancement and harvesting of wildlife, fish and shellfish resources.

Stakeholders will be provided with periodic communications and invited to meetings regarding the Site throughout the RI/FS process (see Section 9.2), Key draft AOC deliverables, as determined by EPA, will be provided for stakeholder review and opportunity for comment.

Site access for field activities will be coordinated with property owners.

9.1.3 Public Involvement

The public will be engaged and kept informed of Site activities in accordance with the Community Involvement Plan (EPA, Date) developed for the Site. EPA will serve as the lead for public engagement efforts, with the support of Cascade and its contractors.

The Community Involvement Coordinator for EPA is:

Debra Sherbina
EPA Region 10, Regional Administration's Division (RAD-202-3)
1200 Sixth Avenue
Seattle, Washington 98101
Phone: (206) 553-0247
E-mail: sherbina.debra@epa.gov

9.2 Project Communications

Periodic communications between the RPM, the Project Coordinator, and the consultants are conducted to minimize delays and to facilitate identification and resolution of potential problems. Project communications include:

- **Progress Reports.** In accordance with the AOC, quarterly progress reports are due to EPA by the 15th day of the month following each quarter. The current schedule involves submittal of progress reports by January 15th, April 15th, July 15th, and October 15th of each year.

- **Meetings and Teleconferences.** In accordance with the AOC, monthly status calls or meetings are conducted with EPA, unless EPA and Cascade agree to cancel or postpone. Additional meetings and teleconferences are conducted on an as-needed basis. Additional meetings or teleconferences may be held with EPA in presenting initial findings of the RI/FS and risk assessment, evaluating data evaluation approaches, assessing data gap fulfillment, and reviewing deliverables.
- **Stakeholder Briefings.** In accordance with the AOC, periodic briefings on the work will be coordinated with EPA and project stakeholders.
- **Notifications.** In accordance with the AOC, Cascade will notify EPA a minimum of two weeks prior to planned field activities.
- **Field Activities and Data Communication.** As described in the field communication plan of the Upland and Marine SQAPPs (Appendices A and B), field activities and data (including daily logs, photos, maps/sketches, and monitoring forms) and preliminary analytical data (including pre-validated laboratory reports and, if needed for decision making, summary data tables and/or figures) will be posted to a password-controlled website for review by Cascade and EPA project teams. The website will be set up, tested, and approved by EPA and Cascade prior to beginning field work. During periods of non-routine⁴⁴ field activities, a weekly status call will be scheduled with EPA and Cascade project teams. Additional meetings or teleconferences to discuss field activities and preliminary data may be scheduled as needed.

9.3 Data Management

Considerable quantities of data have already been obtained and will be collected during the RI field investigation. This data will need to be stored, checked for quality, and presented in reports. This Section outlines how these data will be managed.

Software and procedures are in place to effectively and efficiently handle data generated during the RI. These systems and processes will ensure that data (e.g., sample numbers, methods, qualifications, locations, etc.) are readily accessible and accurately maintained. The primary steps/elements in the data management process are:

- EarthSoft EQuIS 6 environmental chemistry database setup
- gINT geological boring log database setup
- Sample and analysis planning
- Sample collection

⁴⁴ Routine activities include periodic site inspections and groundwater monitoring events.

- Field measurements
- Documentation of location of field activities (GPS, survey, etc.)
- Laboratory analytical data management
- Preliminary reporting and data QA/QC
- Formal data validation (details provided in the SQAPPs) and associated database updates
- Development of maps and tables from EQuIS database, integrated with GIS software as appropriate, to support RI/FS reporting requirements
- Analytical data submittals in accordance with USEPA's Region 10 Data Submission Process for WQX Compatible Deliverables
- Geographic Information Systems (GIS) data submittals in accordance with U.S. EPA Region 10 GIS Data Deliverable Guidance (ed. March 2013)

Data will be collected and recorded in a variety of ways during this project. These include standard field forms (e.g., field data sheets, chain-of-custody forms, and boring logs) and laboratory-generated analytical data. Information about exploration locations, samples, laboratory tests, field measurements and analytical results will be maintained in an EarthSoft EQuIS 6 database. These data will be loaded to EQuIS from electronic data deliverables (EDDs) and preliminarily checked for completeness and fidelity against associated reports and documentation. Lithological data will be entered into the gINT database from boring logs under supervision by professional geologists. Access to the EQuIS and gINT databases will be limited to trained project personnel, and the ability add or change data will be granted to only those trained, professional data managers, chemists, and geologists.

Lab reports and other source documents (including original laboratory EDDs) will be filed electronically according to the project-specific storage and retention policies. All electronic data (including the EQuIS and gINT databases) will be backed up nightly in accordance with industry practices.

Data validation will be performed in accordance with the project SQAPPs. Data validation reports will be filed electronically (along with other source documents) and any associated updates to analytical data (including qualifiers and other validation notes) will be added/updated in EQuIS, as appropriate.

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TABLES

Table 2-1 - Monitoring Well Construction Information and Groundwater Elevation Measurements

Bremerton Gas Works Superfund Site
Bremerton, Washington

Well Identification	Installed By	Date Installed	Surface Elevation (Datum Unknown)	Total Boring Depth (Feet)	Depth to Top of Screen (Feet)	Depth to Bottom of Screen (Feet)	Depth to Water (feet below TOC)	Groundwater Elevation (feet NAVD 88)
							1-Jun-07	1-Jun-07
MP-04	E&E	5/13/2008	12.38	40	30	40	--	--
SP-02	E&E	5/12/2008	10.44	35	25	35	--	--
			Surface Elevation in feet (NAVD 88)					
MW-1	GeoEngineers	5/21/2007	45.03	46.5	30	45	34.68	10.35
MW-2	GeoEngineers	5/21/2007	42.54	46.5	30	45	35.25	7.29
MW-3	GeoEngineers	5/22/2007	39.1	46.5	30	45	32.9	6.2
MW-4	GeoEngineers	5/23/2007	35.2	41.5	20	40	29.32	5.88
MW-5	GeoEngineers	5/24/2007	18.51	21.5	5	20	15.21	3.3
MW-6	GeoEngineers	5/22/2007	34.95	36.5	15	35	30.2	4.75
MW-7	GeoEngineers	5/23/2007	33.24	36.5	15	35	30.21	3.03
MW-8	GeoEngineers	5/22/2007	35.56	41.5	20	40	32.64	2.92

Notes:

-- = not measured

E&E = Ecology and Environment

NAVD 88 = North American Vertical Datum of 1988

TOC = top of casing

Table 3-1 – Potential ARARs, Chemical-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Safe Drinking Water Act	Federal Primary Drinking Water Standards – MCLs and MCLGs	42 USC 300f; 40 CFR 141, Subpart O	Establishes drinking water standards for public water systems to protect human health. Includes standards for the following Site chemicals of concern: arsenic, benzene, and benzo(a)pyrene. The National Contingency Plan states that MCLs, not MCLGs, are ARARs for usable aquifers.	ARARs for groundwater that could potentially be used for drinking water, where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections.
Safe Drinking Water Act	Federal Secondary Drinking Water Standards – Secondary MCLs	42 USC 300f; 40 CFR 143	Establishes drinking water standards for public water systems to achieve the aesthetic qualities of drinking water (secondary MCLs).	TBC for groundwater that could potentially be a drinking water source (i.e., achieved as practicable).
Clean Water Act	Federal Ambient Water Quality Criteria	33 USC 1311–1317; 40 CFR 131	Under Clean Water Act, Section 304(a), minimum criteria are developed for water quality programs established by states. Two kinds of water quality criteria are developed: one for protection of human health, and one for protection of aquatic life. The federal recommended water quality criteria are published on EPA's website: http://water.epa.gov/scitech/swguidance/standards/current/index.cfm	ARARs for surface water if more stringent than promulgated state criteria.
EPA Superfund Soil Screening Guidance	Risk-Based, Site-Specific Soil Screening Levels (SSLs)		Provides guidance with a tiered framework for developing risk-based, site-specific soil screening levels (SSLs) for the protection of human health.	ARARs for soil
Surface Water Quality Standards	State Ambient Water Quality Criteria	Chapter 90.48 RCW; Chapter 173-201A WAC	Establishes water quality standards for protection of human health and for protection of aquatic life (for both acute and chronic exposure durations).	ARARs for surface water where Washington State has adopted, and EPA has approved, water quality standards.

Table 3-1 – Potential ARARs, Chemical-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Model Toxics Control Act	State Soil, Air, Groundwater, and Surface Water Cleanup Standards	Chapter 70.105D RCW; Chapter 173-340 WAC	Establishes cleanup levels for Site groundwater, surface water, soil, and air, including rules for evaluating cross-media protectiveness for all potential receptors (humans and terrestrial plants and animals). MTCA cleanup levels cannot be set at concentrations below natural background.	Promulgated numeric cleanup levels are ARARs for soil, air, groundwater, and surface water. Equations to develop cleanup levels are not ARARs.
Sediment Management Standards	State Sediment Quality Criteria	Chapters 90.48 & 70.105D RCW; Chapter 173-204 WAC	Establishes both numerical and biological wasting-based standards for the protection of benthic invertebrates in marine sediments. The current rule also defines methods for establishing cleanup levels protective of human health, including protection from risks associated with seafood consumption, analytical considerations, and natural and regional background contamination levels.	SMS cleanup levels will serve as ARARs for the development of sediment cleanup levels.

Notes:

ARAR = applicable or relevant and appropriate requirement

CFR = Code of Federal Regulations

EPA = U.S. Environmental Protection Agency

MCL = maximum contaminant level

MCLG = maximum contaminant level goal

MTCA = Model Toxics Control Act

RCW = Revised Code of Washington

SMS = Sediment Management Standards

TBC = to be considered

USC = United States Code

WAC = Washington Administrative Code

Table 3-2 – Potential ARARs, Location-Specific

Bremerton Gas Works Superfund Site
Bremerton, Washington

Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Endangered Species Act	Effects on Endangered Species	16 USC 1531 et seq.; 50 CFR 17	Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats, or must take appropriate mitigation steps.	ARAR for remedial actions that may adversely affect endangered or threatened species or critical habitat present at the Site.
Treaty of Point Elliott, 1855	Tribal lands, hunting, and fishing rights	Articles of agreement and convention made and concluded at Point Elliott, in the territory of Washington. Ratified March 8, 1859. Proclaimed April 11, 1859.	Article 5 secures Tribal right of taking fish at usual and accustomed grounds and stations.	ARAR for fish for shellfish harvest in and adjacent to the Site.
Safe Drinking Water Act	Underground Injection Control, Sole Source Aquifer Program, and Wellhead Protection Program	42 USC 300h–300h-8; 40 CFR 300.400(g)(4); Chapter 173-160 WAC; WAC 246-290-135	Resource planning programs designed to prevent contamination of underground sources of drinking water.	The requirements of the City’s wellhead protection program are TBCs as a performance standard for groundwater that is a potential drinking water source (i.e., achieved as practicable). (Note that there are no water supply wells near the Site that are currently regulated by the City’s program.)
Migratory Bird Treaty Act of 1918	Protection of Migratory Birds	16 USC 703-712 50 CFR 10.13	Makes it illegal to take, possess, sell, purchase or barter any migratory bird except under the terms of a valid permit.	ARAR if migratory birds are impacted during investigation or remedial action.

Table 3-2 – Potential ARARs, Location-Specific

Bremerton Gas Works Superfund Site
Bremerton, Washington

Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Magnuson-Stevens Fishery Conservation and Management Act	Habitat Impacts	16 USC 1855(b); 50 CFR 600.920	Requires evaluation of impacts on EFH if activities may adversely affect EFH.	ARAR if the remedial action may adversely affect EFH.
Executive Order for Wetlands Protection	Wetlands Impacts	Executive Order 11990 (1977), 40 CFR 6.302(a); 40 CFR 6, App. A	Requires measures to avoid adversely affecting wetlands whenever possible, to minimize wetland destruction, and to preserve the value of wetlands.	ARAR for assessing impacts on wetlands, if any, from the remedial action and for developing appropriate compensatory mitigation.
Marine Mammal Protection Act, and the	Protection of Marine Mammals	16 USC Chapter 31	Prohibits the taking (to hunt harass, capture, or kill) of marine mammals in U.S. waters.	ARAR if marine mammals are impacted during investigation or remedial action.
Marine Protection, Research, and Sanctuaries Act	Ocean Dumping	16 USC § 1431 et seq. and 33 USC §1401 et seq.	Prohibits transportation of material from the U.S. for purpose of ocean dumping; transportation of material from anywhere for the purpose of ocean dumping by U.S. agencies or U.S.-flagged vessels; dumping of material transported from outside the U.S. into the U.S. territorial sea except under the terms of a valid permit.	ARAR if ocean dumping is planned to occur, except under the terms of a valid permit.

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Table 3-2 – Potential ARARs, Location-Specific

Bremerton Gas Works Superfund Site
Bremerton, Washington

Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Fish and Wildlife Conservation Act ("Nongame Act")	Conservation of nongame fish and wildlife	16 USC 2901-2911	Authorizes financial and technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife.	ARAR if conservation plans and programs for nongame fish and wildlife are implemented.
Bald Eagle Protection Act	Protection of Bald and Golden Eagles	16 USC 668(a); 50 CFR 22	Prohibits the take, possession, sale, purchase, barter, transport or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, except under the terms of a valid permit	ARAR if bald or golden eagles are impacted during investigation or remedial action.

Notes:

ARAR = applicable or relevant and appropriate requirement

CFR = Code of Federal Regulations

City = City of Bremerton

EFH = essential fish habitat

TBC = to be considered

USC = United States Code

WAC = Washington Administrative Code

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Table 3-3 – Potential ARARs, Action-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Remedial Activity	Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Soil Excavation and Upland Filling	Solid Waste Disposal Act	Management and Disposal of Solid Waste	42 USC 6901–6917; 40 CFR 257–258	Establishes requirements for the management and disposal of solid wastes.	ARAR for remedial actions that result in upland disposal of excavated or dredged material.
	Resource Conservation and Recovery Act (RCRA); Washington Hazardous Waste Management Act and Dangerous Waste Regulations	Generation and Management (Transportation, Treatment, Storage, and Disposal) of Hazardous Waste; Off-Site Land Disposal Considerations	42 USC 6921–22; 40 CFR 260, 261, and 268; Chapter 70.105 RCW; Chapter 173-303 WAC (Chapter 173-307 WAC Pollution Prevention Plans is a TBC)	Defines solid wastes subject to regulation as hazardous wastes. Requires management of hazardous waste from “cradle to grave” unless exemption applies. MGP wastes are subject to certain exemptions (e.g., Bevill Amendment provisions)	ARAR for wastes and soils sediments excavated from the Site for off-site disposal, and a TBC for on-site stabilization or containment actions.
	Hazardous Materials Transportation Act	Transport of Hazardous Materials	49 USC 5101 et seq.; 49 CFR 171–177	Establishes requirements for transport of hazardous materials.	ARAR for those hazardous materials (e.g., DNAPL) transported off site.
	Washington Hydraulics Code	Filling of Wetlands	Chapters 75.20 and 77.55 RCW; Chapter 220-110 WAC	Establishes requirements for performing work that would alter existing jurisdictional wetlands.	ARAR if remedial actions such as excavation or capping affect existing jurisdictional wetlands. Remedial actions must result in no net loss of aquatic habitat and function after sequential consideration of avoidance and mitigation, allowing for site-specific evaluations of existing wetland functions.

Table 3-3 – Potential ARARs, Action-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Remedial Activity	Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Soil Excavation and Upland Filling (Continued)	City of Bremerton Shoreline Master Program and Critical Areas Regulations	Shoreline of Statewide Significance; Fish and Wildlife Habitat Conservation Areas	Chapter 90.58 RCW; Chapter 173-14 WAC; City of Bremerton Ordinance #5299 (effective December 4, 2013); Critical Area Regulations (BMC 20.14) are incorporated into the SMP by reference	Establishes replacement requirements for FWHCAs affected by remedial actions to ensure no net loss of existing ecological function; also establishes requirements for buffers and setbacks from shorelines.	ARAR if remedial actions such as excavation or capping result in impacts within 200 feet of ordinary high water mark or designated FWHCAs. Remedial actions must result in no net loss of aquatic habitat and function after sequential consideration of avoidance and mitigation, allowing for site-specific evaluations of existing shoreline habitat and FWHCAs. Washington's vested rights rule governs which SMP requirements apply in a given circumstance. Substantive requirements of the SMP that were in effect when redevelopment project applications were filed may be ARARs for future redevelopment actions at the Site.
Dredging, Capping, and/or Discharge to Puget Sound	Clean Water Act	Federal Ambient Water Quality Criteria	33 USC 1311–1317; 40 CFR 131	Regulates activities that may result in discharges into navigable waters.	ARAR for control of short-term impacts on surface water due to implementation of remedial actions that include dredging, capping, and discharge of treated water into Puget Sound. Incorporates the substantive provisions of relevant and appropriate Joint Aquatic Resources Permit Application (JARPA), Nationwide Permit, and stormwater regulation requirements.

Table 3-3 – Potential ARARs, Action-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Remedial Activity	Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Dredging, Capping, and/or Discharge to Puget Sound (Continued)	Surface Water Quality Standards	State Ambient Water Quality Criteria	Chapter 90.48 RCW; Chapter 173-201A WAC	Regulates activities that may result in discharges into navigable waters.	ARAR for control of short-term impacts on surface water due to implementation of remedial actions that include dredging, capping, and discharge of treated water into Puget Sound. Incorporates the substantive provisions of relevant and appropriate requirements, where Washington State has adopted, and EPA has approved, water quality standards.
	Clean Water Act	Discharge of Materials into Puget Sound	33 USC 1344; 40 CFR 230	Regulates discharge of dredged and fill material into navigable waters of the United States.	ARAR for dredging and capping activities in Puget Sound.
	Clean Water Act	Discharge of Materials into Puget Sound	33 USC 1251; 40 CFR 122, 123 and 124	Implements the National Pollutant Discharge Elimination System (NPDES) Program, which regulates discharge of pollutants from any point source into waters of the United States.	ARAR for remedial actions if construction stormwater and/or treated water is discharged into Puget Sound.
	Fish and Wildlife Coordination Act	Discharge of Materials, Impoundment or Diversion of Waters in Puget Sound	16 USC 662 and 663; 40 CFR 6.302(g)	Requires federal agencies to consider effects on fish and wildlife from projects that may alter a body of water and mitigate or compensate for project-related losses, which include discharges of pollutants to water bodies.	ARAR for in-water remedial actions or if treated water is discharged into Puget Sound.
	River and Harbors Act	Placement of Structures in Puget Sound	33 USC 401 et seq.; 33 CFR 320–330	Prohibits the unauthorized obstruction or alteration of any navigable water. Establishes requirements for structures or work in, above, or under navigable waters.	ARAR for remedial actions in Puget Sound.

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Table 3-3 – Potential ARARs, Action-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Remedial Activity	Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Dredging, Capping, and/or Discharge to Puget Sound (Continued)	Washington Hydraulics Code	Filling in Puget Sound	Chapter 75.20 and 77.55 RCW; Chapter 220-110 WAC	Establishes requirements for performing work that would use, divert, obstruct, or change the natural flow or bed of Puget Sound.	ARAR for shoreline excavation, dredging, and/or capping actions. Remedial actions must result in no net loss of aquatic habitat or function after sequential consideration of avoidance and mitigation.
Other Remedial Activities	Federal Clean Air Act; Washington Clean Air Act; Puget Sound Air Clean Air Agency Regulations	Air Emission Discharges	42 USC 7401 et seq.; Chapter 70.94 RCW; Chapter 173-400 WAC; PSCAA Regulation III	Regulates air emission discharges.	ARAR for remedial activities that generate fugitive dust or other air emissions, including treatment operations.
	Washington State Minimum Standards for Construction and Maintenance of Wells	Well Construction	Chapter 18.104 RCW; Chapter 173-160 WAC	Establishes minimum standards for the construction and decommissioning of all wells in the state of Washington.	ARAR for remedial activities that include installation and construction of monitoring wells or remediation wells used to inject any substance to remediate or control contamination.
	Historic Preservation Act; Washington Historical Activities Act	Alteration of Historic Properties	16 USC 470 et seq.; 36 CFR 800; Chapter 27 RCW	Requires the identification of historic properties potentially affected by remedial actions, and ways to avoid, minimize, or mitigate such effects. Historic property is any district, site, building, structure, or object included in or eligible for the National Register of Historic Places, including artifacts, records, and material remains related to such a property.	ARAR if historic properties are affected by remedial activities. No historic properties have been identified at the Site to date but could potentially be identified during remedial design.
	Archeological and Historic Preservation Act	Alteration of Historic and Archaeological Properties	16 USC 469a-1	Provides for the preservation of historical and archeological data that may be irreparably lost as a result of a federally approved project and mandates only preservation of the data.	ARAR if historical and archeological resources may be irreparably lost by implementation of remedial activities.

Table 3-3 – Potential ARARs, Action-Specific

Bremerton Gas Works Superfund Site

Bremerton, Washington

Remedial Activity	Act/Authority	Criteria/Issue	Citation	Brief Description	Applicability/Appropriateness
Other Remedial Activities (Continued)	Native American Graves Protection and Reparation Act	Alteration of American Graves	25 USC 3001–3013; 43 CFR 10	Requires federal agencies and museums that have possession of or control over Native American cultural items (including human remains, associated and unassociated funerary items, sacred objects, and objects of cultural patrimony) to compile an inventory of such items. Prescribes when such federal agencies and museums must return Native American cultural items. “Museums” are defined as any institution or state or local government agency that receives federal funds and has possession of, or control over, Native American cultural items.	ARAR if Native American cultural items are present in an excavation or dredging area.

Notes:

ARAR = applicable or relevant and appropriate requirements

BMC = Bremerton Municipal Code

DNAPL = dense non-aqueous phase liquid

EPA = U.S. Environmental Protection Agency

FWHCA = Fish and Wildlife Habitat Conservation Area

MGP = manufactured gas plant

PSCCA = Puget Sound Clean Air Agency

RCW = Revised Code of Washington

SMP = Shoreline Master Program

TBC = to be considered

USC = United States Code

WAC = Washington Administrative Code

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Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Conventionals (mg/kg)										
Cyanide, WAD	57-12-5	--	--	--	--	2.3	15	0.05	2.3	2.3
Cyanide, total	57-12-5	--	--	--	--	2.3	15	0.05	2.3	2.3
Metals (mg/kg)										
Aluminum	7429-90-5	--	--	--	--	7,700	110,000		7,700	7,700
Antimony	7440-36-0	--	78	0.27	--	3.1	47	0.2	0.27	3.1
Arsenic	7440-38-2	43	--	46	18	0.68	3	0.5	0.68	0.68
Barium	7440-39-3	--	330	2,000	--	1,500	22,000		330	1,500
Beryllium	7440-41-7	--	40	21	--	16	230	0.2	16	16
Cadmium	7440-43-9	0.77	140	0.36	32	7.1	98	0.1	0.36	7.1
Chromium	7440-47-3	26	--	34	--	--	--	0.5	26	--
Chromium III	16065-83-1	26	--	34	--	12,000	180,000		26	12,000
Chromium VI	18540-29-9	--	--	130	--	0.3	6.3	0.4	0.3	0.3
Cobalt	7440-48-4	120	--	230	13	2.3	35	0.2	2.3	2.3
Copper	7440-50-8	28	80	49	70	310	4700	0.5	28	310
Iron	7439-89-6	--	--	--	--	5,500	82,000		5,500	5,500
Lead	7439-92-1	11	1,700	56	120	400	800	0.1	11	400
Manganese	7439-96-5	4,300	450	4,000	220	180	2,600	0.5	180	180
Mercury	7439-97-6	--	--	--	--	1.1	4.6	0.025	1.1	1.1
Nickel	7440-02-0	210	280	130	38	150	2,200	0.5	38	150
Selenium	7782-49-2	1.2	4.1	0.63	0.52	39	580	0.5	0.52	39
Silver	7440-22-4	4.2	--	14	560	39	580	0.2	4.2	39
Thallium	7440-28-0	--	--	--	--	0.078	1.2	0.2	0.078	0.078
Vanadium	7440-62-2	7.8	--	280	--	39	580		7.8	39
Zinc	7440-66-6	46	120	79	160	2,300	35,000	4	46	2,300
Metals, Organic (mg/kg)										
Tributyltin	688-73-3	--	--	--	--	2.3	35		2.3	2.3
Volatile Organic Compounds (VOCs) (mg/kg)										
1,1,1,2-Tetrachloroethane	630-20-6	--	--	--	--	2	8.8	0.001	2	2
1,1,1-Trichloroethane	71-55-6	--	--	--	--	810	3,600	0.001	810	810
1,1,2,2-Tetrachloroethane	79-34-5	--	--	--	--	0.6	2.7	0.001	0.6	0.6
1,1,2-Trichloroethane	79-00-5	--	--	--	--	0.15	0.63	0.001	0.15	0.15
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	--	--	--	--	4,000	17,000	0.002	4,000	4,000
1,1-Dichloroethane	75-34-3	--	--	--	--	3.6	16	0.001	3.6	3.6
1,1-Dichloroethene	75-35-4	--	--	--	--	23	100	0.001	23	23
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	6.3	93	0.005	6.3	6.3
1,2,3-Trichloropropane	96-18-4	--	--	--	--	0.0051	0.11	0.002	0.0051	0.0051
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	5.8	24	0.001	5.8	5.8
1,2-Dibromo-3-chloropropane	96-12-8	--	--	--	--	0.0053	0.064	0.005	0.0053	0.0053

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Volatile Organic Compounds (VOCs) (mg/kg) (continued)										
1,2-Dichloroethane	107-06-2	--	--	--	--	0.46	2	0.001	0.46	0.46
1,2-Dichloroethene, cis-	156-59-2	--	--	--	--	16	230	0.001	16	16
1,2-Dichloroethene, trans-	156-60-5	--	--	--	--	160	2300	0.001	160	160
1,2-Dichloropropane	78-87-5	--	--	--	--	1	4.4	0.001	1	1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	--	--	--	--	78	1,200	0.001	78	78
1,3-Dichloropropane	142-28-9	--	--	--	--	160	2,300	0.001	160	160
1,3-Dichloropropene, cis-	10061-01-5	--	--	--	--	--	--	0.001	--	--
1,3-Dichloropropene, trans-	10061-02-6	--	--	--	--	--	--	0.001	--	--
1,4-Dichloro-2-butene, trans-	110-57-6	--	--	--	--	0.0074	0.032	0.005	0.0074	0.0074
2-Butanone (MEK)	78-93-3	--	--	--	--	2,700	19,000	0.005	2,700	2,700
2-Chlorotoluene	95-49-8	--	--	--	--	160	2,300		160	160
2-Hexanone (Methyl butyl ketone)	591-78-6	--	--	--	--	20	130	0.005	20	20
4-Chlorotoluene	106-43-4	--	--	--	--	160	2,300	0.001	160	160
4-Isopropyltoluene (4-Cymene)	99-87-6	--	--	--	--	--	--	0.001	--	--
Acetone	67-64-1	--	--	--	--	6,100	67,000	0.005	6,100	6,100
Acrolein	107-02-8	--	--	--	--	0.014	0.06	0.05	0.014	0.014
Acrylonitrile	107-13-1	--	--	--	--	0.25	1.1	0.005	0.25	0.25
Benzene	71-43-2	--	--	--	--	1.2	5.1	0.001	1.2	1.2
Bromobenzene	108-86-1	--	--	--	--	29	180	0.001	29	29
Bromochloromethane	74-97-5	--	--	--	--	15	63	0.001	15	15
Bromodichloromethane	75-27-4	--	--	--	--	0.29	1.3	0.001	0.29	0.29
Bromoform (Tribromomethane)	75-25-2	--	--	--	--	19	86	0.001	19	19
Bromomethane (Methyl bromide)	74-83-9	--	--	--	--	0.68	3	0.001	0.68	0.68
Carbon disulfide	75-15-0	--	--	--	--	77	350	0.001	77	77
Carbon tetrachloride (Tetrachloromethane)	56-23-5	--	--	--	--	0.65	2.9	0.001	0.65	0.65
Chlorobenzene	108-90-7	--	--	--	--	28	130	0.001	28	28
Chloroethane	75-00-3	--	--	--	--	1,400	5,700	0.001	1,400	1,400
Chloroform	67-66-3	--	--	--	--	0.32	1.4	0.001	0.32	0.32
Chloromethane	74-87-3	--	--	--	--	11	46	0.001	11	11
Cyclohexane	110-82-7	--	--	--	--	650	2,700		650	650
Dibromochloromethane	124-48-1	--	--	--	--	8.3	39	0.001	8.3	8.3
Dibromomethane	74-95-3	--	--	--	--	2.4	9.9	0.001	2.4	2.4
Dichlorodifluoromethane	75-71-8	--	--	--	--	8.7	37	0.001	8.7	8.7
Dichloromethane (Methylene chloride)	75-09-2	--	--	--	--	35	320	0.002	35	35
Ethylbenzene	100-41-4	--	--	--	--	5.8	25	0.001	5.8	5.8
Ethylene dibromide (1,2-Dibromoethane)	106-93-4	--	--	--	--	0.036	0.16	0.001	0.036	0.036
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87-68-3	--	--	--	--	1.2	5.3	0.005	1.2	1.2

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Volatile Organic Compounds (VOCs) (mg/kg) (continued)										
Isopropylbenzene (Cumene)	98-82-8	--	--	--	--	190	990	0.001	190	190
Methyl acetate	79-20-9	--	--	--	--	7,800	120,000		7,800	7,800
Methyl iodide (Iodomethane)	74-88-4	--	--	--	--	--	--	0.001	--	--
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	108-10-1	--	--	--	--	3,300	14,000	0.005	3,300	3,300
Methyl tert-butyl ether (MTBE)	1634-04-4	--	--	--	--	47	210	0.001	47	47
n-Butylbenzene	104-51-8	--	--	--	--	390	5,800	0.001	390	390
n-Propylbenzene	103-65-1	--	--	--	--	380	2,400	0.001	380	380
o-Xylene	95-47-6	--	--	--	--	65	280	0.001	65	65
sec-Butylbenzene	135-98-8	--	--	--	--	780	12,000	0.001	780	780
Styrene	100-42-5	--	--	--	--	600	3,500	0.001	600	600
tert-Butylbenzene	98-06-6	--	--	--	--	780	12,000	0.001	780	780
Tetrachloroethene (PCE)	127-18-4	--	--	--	--	8.1	39	0.001	8.1	8.1
Toluene	108-88-3	--	--	--	--	490	4,700	0.001	490	490
Total xylene (reported, not calculated)	1330-20-7	--	--	--	--	58	250	0.002	58	58
Trichloroethene (TCE)	79-01-6	--	--	--	--	0.41	1.9	0.001	0.41	0.41
Trichlorofluoromethane (Fluorotrichloromethane)	75-69-4	--	--	--	--	2,300	35,000	0.001	2,300	2,300
Vinyl acetate	108-05-4	--	--	--	--	91	380	0.005	91	91
Vinyl chloride	75-01-4	--	--	--	--	0.059	1.7	0.001	0.059	0.059
Semivolatile Organic Compounds (SVOCs) (mg/kg)										
1,2,4,5-Tetrachlorobenzene	95-94-3	--	--	--	--	2.3	35	0.067	2.3	2.3
1,2,4-Trichlorobenzene	120-82-1	--	--	--	--	5.8	26	0.067	5.8	5.8
1,2-Dichlorobenzene	95-50-1	--	--	--	--	180	930	0.067	180	180
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	--	0.067	--	--
1,4-Dichlorobenzene	106-46-7	--	--	--	--	2.6	11	0.067	2.6	2.6
1,4-Dioxane	123-91-1	--	--	--	--	5.3	24	0.067	5.3	5.3
2,2'-Oxybis (1-chloropropane)	108-60-1	--	--	--	--	310	4,700	0.067	310	310
2,3,4,6-Tetrachlorophenol	58-90-2	--	--	--	--	190	2,500	0.067	190	190
2,4,5-Trichlorophenol	95-95-4	--	--	--	--	630	8,200	0.33	630	630
2,4,6-Trichlorophenol	88-06-2	--	--	--	--	6.3	82	0.33	6.3	6.3
2,4-Dichlorophenol	120-83-2	--	--	--	--	19	250	0.33	19	19
2,4-Dimethylphenol	105-67-9	--	--	--	--	130	1600	0.067	130	130
2,4-Dinitrophenol	51-28-5	--	--	--	--	13	160	0.67	13	13
2,4-Dinitrotoluene	121-14-2	--	--	--	--	1.7	7.4	0.33	1.7	1.7
2,6-Dinitrotoluene	606-20-2	--	--	--	--	0.36	1.5	0.33	0.36	0.36
2-Chloronaphthalene	91-58-7	--	--	--	--	480	6,000	0.067	480	480

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Semivolatile Organic Compounds (SVOCs) (mg/kg) (continued)										
2-Chlorophenol	95-57-8	--	--	--	--	39	580	0.067	39	39
2-Methylphenol (o-Cresol)	95-48-7	--	--	--	--	320	4,100	0.067	320	320
2-Nitroaniline	88-74-4	--	--	--	--	63	800	0.33	63	63
2-Nitrophenol	88-75-5	--	--	--	--	--	--	0.067	--	--
3,3'-Dichlorobenzidine	91-94-1	--	--	--	--	1.2	5.1	0.33	1.2	1.2
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	1319-77-3	--	--	--	--	630	8200		630	630
3-Methylphenol (m-Cresol)	108-39-4	--	--	--	--	320	4100		320	320
3-Nitroaniline	99-09-2	--	--	--	--	--	--	0.33	--	--
4-Bromophenyl-phenyl ether	101-55-3	--	--	--	--	--	--	0.067	--	--
4-Chloro-3-methylphenol	59-50-7	--	--	--	--	630	8,200	0.33	630	630
4-Chloroaniline	106-47-8	--	--	--	--	2.7	11	0.33	2.7	2.7
4-Methylphenol (p-Cresol)	106-44-5	--	--	--	--	630	8200	0.067	630	630
4-Nitroaniline	100-01-6	--	--	--	--	25	110	0.33	25	25
4-Nitrophenol	100-02-7	--	--	--	--	--	--	0.33	--	--
Aniline	62-53-3	--	--	--	--	44	400	0.067	44	44
Benzidine	92-87-5	--	--	--	--	0.00053	0.01		0.00053	0.00053
Benzoic acid	65-85-0	--	--	--	--	25,000	330,000	0.67	25,000	25,000
Benzyl alcohol	100-51-6	--	--	--	--	630	8,200	0.33	630	630
Biphenyl (1,1'-Biphenyl)	92-52-4	--	--	--	--	4.7	20	0.005	4.7	4.7
bis(2-Chloroethoxy)methane	111-91-1	--	--	--	--	19	250	0.067	19	19
bis(2-Chloroethyl)ether	111-44-4	--	--	--	--	0.23	1	0.067	0.23	0.23
bis(2-Ethylhexyl)phthalate	117-81-7	--	--	--	--	39	160	0.067	39	39
Butylbenzyl phthalate	85-68-7	--	--	--	--	290	1,200	0.067	290	290
Dibenzofuran	132-64-9	--	--	--	--	7.3	100	0.067	7.3	7.3
Diethyl phthalate	84-66-2	--	--	--	--	5,100	66,000	0.067	5,100	5,100
Dimethyl phthalate	131-11-3	--	--	--	--	--	--	0.067	--	--
Di-n-butyl phthalate	84-74-2	--	--	--	--	630	8,200	0.067	630	630
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	534-52-1	--	--	--	--	0.51	6.6	0.67	0.51	0.51
Di-n-octyl phthalate	117-84-0	--	--	--	--	63	820	0.067	63	63
Hexachlorobenzene	118-74-1	--	--	--	--	0.21	0.96	0.067	0.21	0.21
Hexachlorocyclopentadiene	77-47-4	--	--	--	--	0.18	0.75	0.33	0.18	0.18
Hexachloroethane	67-72-1	--	--	--	--	1.8	8	0.067	1.8	1.8
Isophorone	78-59-1	--	--	--	--	570	2,400	0.067	570	570
Nitrobenzene	98-95-3	--	--	--	--	5.1	22	0.067	5.1	5.1
n-Nitrosodimethylamine	62-75-9	--	--	--	--	0.002	0.034	0.33	0.002	0.002
n-Nitrosodi-n-propylamine	621-64-7	--	--	--	--	0.078	0.33	0.067	0.078	0.078

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Semivolatile Organic Compounds (SVOCs) (mg/kg) (continued)										
n-Nitrosodiphenylamine	86-30-6	--	--	--	--	110	470	0.067	110	110
Pentachlorophenol	87-86-5	2.1	31	2.8	5	1	4	0.33	1	1
Phenol	108-95-2	--	--	--	--	1900	25000	0.067	1900	1900
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg)										
1-Methylnaphthalene	90-12-0	--	--	--	--	18	73	0.005	18	18
2-Methylnaphthalene	91-57-6	--	--	--	--	24	300	0.005	24	24
Acenaphthene	83-32-9	--	--	--	--	360	4,500	0.005	360	360
Acenaphthylene	208-96-8	--	--	--	--	--	--	0.005	--	--
Anthracene	120-12-7	--	--	--	--	1,800	23,000	0.005	1,800	1,800
Benzo(a)anthracene	56-55-3	--	--	--	--	0.16	2.9	0.005	0.16	0.16
Benzo(a)pyrene	50-32-8	--	--	--	--	0.016	0.29	0.005	0.016	0.016
Benzo(b)fluoranthene	205-99-2	--	--	--	--	0.16	2.9	0.005	0.16	0.16
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	--	0.005	--	--
Benzo(k)fluoranthene	207-08-9	--	--	--	--	1.6	29	0.005	1.6	1.6
Chrysene	218-01-9	--	--	--	--	16	290	0.005	16	16
Dibenzo(a,h)anthracene	53-70-3	--	--	--	--	0.016	0.29	0.005	0.016	0.016
Fluoranthene	206-44-0	--	--	--	--	240	3,000	0.005	240	240
Fluorene	86-73-7	--	--	--	--	240	3,000	0.005	240	240
Indeno(1,2,3-c,d)pyrene	193-39-5	--	--	--	--	0.16	2.9	0.005	0.16	0.16
Naphthalene	91-20-3	--	--	--	--	3.8	17	0.005	3.8	3.8
Phenanthrene	85-01-8	--	--	--	--	--	--	0.005	--	--
Pyrene	129-00-0	--	--	--	--	180	2,300	0.005	180	180
Total HPAH	--	--	18	1.1	--	--	--		1.1	--
Total LPAH	--	--	29	100	--	--	--		29	--
Total PAH	--	--	--	--	--	--	--		--	--

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)
Organochlorine Pesticides (mg/kg)										
Hexachlorocyclohexane, alpha-BHC	319-84-6	--	--	--	--	0.086	0.36	0.0017	0.086	0.086
Hexachlorocyclohexane, beta-BHC	319-85-7	--	--	--	--	0.3	1.3	0.0017	0.3	0.3
Hexachlorocyclohexane, gamma-BHC (Lindane)	58-89-9	--	--	--	--	0.57	2.5	0.0017	0.57	0.57
Hexachlorocyclohexane, delta-BHC	319-86-8	--	--	--	--	--	--	0.0017	--	--
Heptachlor	76-44-8	--	--	--	--	0.13	0.63	0.0017	0.13	0.13
Aldrin	309-00-2	--	--	--	--	0.039	0.18	0.0017	0.039	0.039
Heptachlor epoxide	1024-57-3	--	--	--	--	0.07	0.33	0.0017	0.07	0.07
Chlordane	57-74-9	--	--	--	--	--	--	0.0017	--	--
Chlordane (technical)	12789-03-6	--	--	--	--	1.7	7.7	0.0017	1.7	1.7
Endosulfan-alpha (I)	959-98-8	--	--	--	--	--	--	0.0017	--	--
4,4'-DDE (p,p'-DDE)	72-55-9	--	--	--	--	2	9.3	0.0033	2	2
Dieldrin	60-57-1	0.022	--	0.0049	--	0.034	0.14	0.0033	0.0049	0.034
Endrin	72-20-8	--	--	--	--	1.9	25	0.0033	1.9	1.9
Endosulfan-beta (II)	33213-65-9	--	--	--	--	--	--	0.0033	--	--
4,4'-DDD (p,p'-DDD)	72-54-8	--	--	--	--	2.3	9.6	0.0033	2.3	2.3
Endrin aldehyde	7421-93-4	--	--	--	--	--	--	0.0033	--	--
4,4'-DDT (p,p'-DDT)	50-29-3	--	--	--	--	1.9	8.5	0.0033	1.9	1.9
Endosulfan sulfate	1031-07-8	--	--	--	--	--	--	0.0033	--	--
Methoxychlor	72-43-5	--	--	--	--	32	410	0.0017	32	32
Polychlorinated Biphenyls (PCBs) (mg/kg)										
Aroclor 1016	12674-11-2	--	--	--	--	0.41	5.1	0.33	0.41	0.41
Aroclor 1221	11104-28-2	--	--	--	--	0.2	0.83	0.33	0.2	0.2
Aroclor 1232	11141-16-5	--	--	--	--	0.17	0.72	0.33	0.17	0.17
Aroclor 1242	53469-21-9	--	--	--	--	0.23	0.95	0.33	0.23	0.23
Aroclor 1248	12672-29-6	--	--	--	--	0.23	0.95	0.33	0.23	0.23
Aroclor 1254	11097-69-1	--	--	--	--	0.12	0.97	0.33	0.12	0.12
Aroclor 1260	11096-82-5	--	--	--	--	0.24	0.99	0.33	0.24	0.24
Total PCB Aroclors	1336-36-3	--	--	--	--	0.23	0.94	0.33	0.23	0.23

Table 3-4 - Development of Initial PRGs for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Ecological Soil Screening Levels - Birds	EPA Ecological Soil Screening Levels - Invertebrates	EPA Ecological Soil Screening Levels - Mammals	EPA Ecological Soil Screening Levels - Plants	EPA Regional Screening Levels (RSLs) - Residential Soil	EPA Regional Screening Levels (RSLs) - Industrial Soil	Laboratory MRL	Initial PRGs used for Data Screening	
		EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2010	EPA, 2016	EPA, 2016	ARI, 2015	Surface Soil (0-10 feet)	Subsurface Soil (>10 feet)

Notes:

Compounds frequently associated with MGP-operations.

-- indicates not available

CAS = Chemical Abstract Services

EPA = U.S. Environmental Protection Agency

HPAH = high molecular weight PAH

LPAH = low molecular weight PAH

kg = kilogram

mg = miligram

MGP = manufactured gas plant

ng = nanogram

PRG = preliminary remediation goal

RCRA = Resource Conservation and Recovery Act

RSL = regional screening level

ug = microgram

WAD = Weak Acid Dissociable Cyanide

References:

EPA, 2010. Ecological Soil Screening Levels. Updated October 20, 2010. Cited: January 15, 2014. Available from: <http://www.epa.gov/ecotox/ecossl/>.

EPA, 2016. EPA Regional Screening Levels. May 2016. Available from: <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016>.

Table 3-5 - Development of Initial PRGs for Groundwater

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Regional Screening Levels (RSLs) - MCL	EPA Regional Screening Levels (RSLs) - Tapwater	Laboratory MRL ARI, 2015	Initial PRGs used for Data Screening
		EPA, 2016	EPA, 2016		
Conventionals (mg/L)					
Cyanide, free	57-12-5	0.2	0.15	0.00500	0.15
Metals (ug/L)					
Antimony	7440-36-0	6	0.78	0.2	0.78
Arsenic	7440-38-2	10	0.052	0.2	0.052
Barium	7440-39-3	2,000	380		380
Beryllium	7440-41-7	4	2.5	0.2	2.5
Cadmium	7440-43-9	5	0.92	0.1	0.92
Chromium	7440-47-3	100	--	0.5	100
Chromium III	16065-83-1	--	2,200	n/a	2,200
Chromium VI	18540-29-9	--	0.035	0.01	0.035
Cobalt	7440-48-4	--	0.6		0.6
Copper	7440-50-8	1,300	80	0.5	80
Lead	7439-92-1	15	15	0.1	15
Manganese	7439-96-5	--	43		43
Mercury	7439-97-6	2	0.063	0.100	0.063
Nickel	7440-02-0	--	39	0.5	39
Selenium	7782-49-2	50	10	0.5	10
Silver	7440-22-4	--	9.4	0.2	9.4
Thallium	7440-28-0	2	0.02	0.2	0.02
Vanadium	7440-62-2	--	8.6		8.6
Zinc	7440-66-6	--	600	4	600
Metals, Olrganic (ug/L)					
Tributyltin	688-73-3	--	0.37	n/a	0.37
Volatile Organic Compounds (VOCs) (ug/L)					
1,1,1,2-Tetrachloroethane	630-20-6	--	0.57	0.200	0.57
1,1,1-Trichloroethane	71-55-6	200	800	0.200	200
1,1,2,2-Tetrachloroethane	79-34-5	--	0.076	0.200	0.076
1,1,2-Trichloroethane	79-00-5	5	0.041	0.200	0.041
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	--	5,500	0.200	5,500
1,1-Dichloroethane	75-34-3	--	2.8	0.200	2.8
1,1-Dichloroethene	75-35-4	7	28	0.200	7
1,2,3-Trichlorobenzene	87-61-6	--	0.7	0.500	0.7
1,2,3-Trichloropropane	96-18-4	--	0.00075	0.500	0.00075
1,2,4-Trimethylbenzene	95-63-6	--	1.5	0.200	1.5
1,2-Dibromo-3-chloropropane	96-12-8	0.2	0.00033	0.500	0.00033
1,2-Dichloroethane	107-06-2	5	0.17	0.200	0.17
1,2-Dichloroethene, cis-	156-59-2	70	3.6	0.200	3.6
1,2-Dichloroethene, trans-	156-60-5	100	36	0.200	36
1,2-Dichloropropane	78-87-5	5	0.44	0.200	0.44
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	--	12	0.200	12
1,3-Dichloropropane	142-28-9	--	37	0.200	37
1,3-Dichloropropene, cis-	10061-01-5	--	--	0.200	--
1,3-Dichloropropene, trans-	10061-02-6	--	--	0.200	--
1,4-Dichloro-2-butene, trans-	110-57-6	--	0.0013	1.00	0.0013
2-Butanone (MEK)	78-93-3	--	560	5.00	560
2-Chlorotoluene	95-49-8	--	24	0.200	24
2-Hexanone (Methyl butyl ketone)	591-78-6	--	3.8	5.00	3.8
4-Chlorotoluene	106-43-4	--	25	0.200	25
4-Isopropyltoluene (4-Cymene)	99-87-6	--	--	0.200	--
Acetone	67-64-1	--	1,400	5.00	1,400
Acrolein	107-02-8	--	0.0042	5.00	0.0042
Acrylonitrile	107-13-1	--	0.052	1.00	0.052
Benzene	71-43-2	5	0.46	0.200	0.46
Bromobenzene	108-86-1	--	6.2	0.200	6.2
Bromochloromethane	74-97-5	--	8.3	0.200	8.3
Bromodichloromethane	75-27-4	80	0.13	0.200	0.13
Bromoform (Tribromomethane)	75-25-2	80	3.3	0.200	3.3
Bromomethane (Methyl bromide)	74-83-9	--	0.75	1.00	0.75
Carbon disulfide	75-15-0	--	81	0.200	81
Carbon tetrachloride (Tetrachloromethane)	56-23-5	5	0.46	0.200	0.46
Chlorobenzene	108-90-7	100	7.8	0.200	7.8
Chloroethane	75-00-3	--	2,100	0.200	2,100
Chloroform	67-66-3	80	0.22	0.200	0.22
Chloromethane	74-87-3	--	19	0.500	19
Cyclohexane	110-82-7	--	1,300	n/a	1,300
Dibromochloromethane	124-48-1	80	0.87	0.200	0.87

Table 3-5
Final RI/FS Work Plan
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Table 3-5 - Development of Initial PRGs for Groundwater

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Regional Screening Levels (RSLs) - MCL	EPA Regional Screening Levels (RSLs) - Tapwater	Laboratory MRL	Initial PRGs used for Data Screening
		EPA, 2016	EPA, 2016		
Volatile Organic Compounds (VOCs) (ug/L) (continued)					
Dibromomethane	74-95-3	--	0.83	0.200	0.83
Dichlorodifluoromethane	75-71-8	--	20	0.200	20
Dichloromethane (Methylene chloride)	75-09-2	5	11	1.00	5
Ethylbenzene	100-41-4	700	1.5	0.200	1.5
Ethylene dibromide (1,2-Dibromoethane)	106-93-4	0.05	0.0075	0.200	0.0075
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87-68-3	--	0.14	0.500	0.14
Isopropylbenzene (Cumene)	98-82-8	--	45	0.200	45
Methyl acetate	79-20-9	--	2000	n/a	2000
Methyl iodide (Iodomethane)	74-88-4	--	--	1.00	--
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	108-10-1	--	630	5.00	630
Methyl tert-butyl ether (MTBE)	1634-04-4	--	14	0.500	14
n-Butylbenzene	104-51-8	--	100	0.200	100
n-Propylbenzene	103-65-1	--	66	0.200	66
o-Xylene	95-47-6	--	19	0.200	19
sec-Butylbenzene	135-98-8	--	200	0.200	200
Styrene	100-42-5	100	120	0.200	100
tert-Butylbenzene	98-06-6	--	69	0.200	69
Tetrachloroethene (PCE)	127-18-4	5	4.1	0.200	4.1
Toluene	108-88-3	1000	110	0.200	110
Total xylene (reported, not calculated)	1330-20-7	10000	19	n/a	19
Total Xylene	--	--	--	n/a	--
Trichloroethene (TCE)	79-01-6	5	0.28	0.200	0.28
Trichlorofluoromethane (Fluorotrichloromethane)	75-69-4	--	520	0.200	520
Vinyl acetate	108-05-4	--	41	0.200	41
Vinyl chloride	75-01-4	2	0.019	0.200	0.019
Semivolatile Organic Compounds (SVOCs) (ug/L)					
1,2,4,5-Tetrachlorobenzene	95-94-3	--	0.17	n/a	0.17
1,2,4-Trichlorobenzene	120-82-1	70	0.4	0.254	0.4
1,2-Dichlorobenzene	95-50-1	600	30	0.250	30
1,3-Dichlorobenzene	541-73-1	--	--	0.266	--
1,4-Dichlorobenzene	106-46-7	75	0.48	0267	0.48
1,4-Dioxane	123-91-1	--	0.46	0.4	0.46
2,2'-Oxybis (1-chloropropane)	108-60-1	--	71	0.241	71
2,3,4,6-Tetrachlorophenol	58-90-2	--	24	0.244	24
2,4,5-Trichlorophenol	95-95-4	--	120	1.10	120
2,4,6-Trichlorophenol	88-06-2	--	1.2	1.04	1.2
2,4-Dichlorophenol	120-83-2	--	4.6	1.11	4.6
2,4-Dimethylphenol	105-67-9	--	36	1.12	36
2,4-Dinitrophenol	51-28-5	--	3.9	3.35	3.9
2,4-Dinitrotoluene	121-14-2	--	0.24	1.12	0.24
2,6-Dinitrotoluene	606-20-2	--	0.049	1.14	0.049
2-Chloronaphthalene	91-58-7	--	75	0.248	75
2-Chlorophenol	95-57-8	--	9.1	0.220	9.1
2-Methylphenol (o-Cresol)	95-48-7	--	93	0.211	93
2-Nitroaniline	88-74-4	--	19	1.46	19
2-Nitrophenol	88-75-5	--	--	0.263	--
3,3'-Dichlorobenzidine	91-94-1	--	0.13	1.77	0.13
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	1319-77-3	--	150	n/a	150
3-Methylphenol (m-Cresol)	108-39-4	--	93	n/a	93
3-Nitroaniline	99-09-2	--	--	1.53	--
4-Bromophenyl-phenyl ether	101-55-3	--	--	0.238	--
4-Chloro-3-methylphenol	59-50-7	--	140	1.12	140
4-Chloroaniline	106-47-8	--	0.37	1.73	0.37
4-Methylphenol (p-Cresol)	106-44-5	--	190	0.468	190
4-Nitroaniline	100-01-6	--	3.8	2.02	3.8
4-Nitrophenol	100-02-7	--	--	1.75	--
Acetophenone	98-86-2	--	190	n/a	190
Aniline	62-53-3	--	13	0.973	13
Atrazine	1912-24-9	3	0.3	n/a	0.3
Benzaldehyde	100-52-7	--	19	n/a	19
Benzidine	92-87-5	--	0.00011	n/a	0.00011
Benzoic acid	65-85-0	--	7500	3.92	7500
Benzyl alcohol	100-51-6	--	200	0.552	200
Biphenyl (1,1'-Biphenyl)	92-52-4	--	0.083	n/a	0.083
bis(2-Chloroethoxy)methane	111-91-1	--	5.9	0.237	5.9

Table 3-5 - Development of Initial PRGs for Groundwater

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	EPA Regional Screening Levels (RSLs) - MCL	EPA Regional Screening Levels (RSLs) - Tapwater	Laboratory MRL	Initial PRGs used for Data Screening
		EPA, 2016	EPA, 2016		
Semivolatile Organic Compounds (SVOCs) (ug/L) (continued)					
bis(2-Chloroethyl)ether	111-44-4	--	0.014	0.248	0.014
bis(2-Ethylhexyl)phthalate	117-81-7	6	5.6	2.14	5.6
Butylbenzyl phthalate	85-68-7	--	16	0.299	16
Caprolactam	105-60-2	--	990	n/a	990
Dibenzofuran	132-64-9	--	0.79	0.309	0.79
Diethyl phthalate	84-66-2	--	1500	0.273	1500
Dimethyl phthalate	131-11-3	--	--	0.259	--
Di-n-butyl phthalate	84-74-2	--	90	0.291	90
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	534-52-1	--	0.15	3.61	0.15
Di-n-octyl phthalate	117-84-0	--	20	0.268	20
Hexachlorobenzene	118-74-1	1	0.0098	0.280	0.0098
Hexachlorocyclopentadiene	77-47-4	50	0.041	1.08	0.041
Hexachloroethane	67-72-1	--	0.33	0.300	0.33
Isophorone	78-59-1	--	78	0.423	78
Nitrobenzene	98-95-3	--	0.14	0.253	0.14
n-Nitrosodimethylamine	62-75-9	--	0.00011	1.33	0.00011
n-Nitrosodi-n-propylamine	621-64-7	--	0.011	0.269	0.011
n-Nitrosodiphenylamine	86-30-6	--	12	0.299	12
Pentachlorophenol	87-86-5	1	0.041	1.89	0.041
Phenol	108-95-2	--	580	0.271	580
Polycyclic Aromatic Hydrocarbons (PAHs)(ug/L)					
1-Methylnaphthalene	90-12-0	--	1.1	0.0100	1.1
2-Methylnaphthalene	91-57-6	--	3.6	0.0100	3.6
Acenaphthene	83-32-9	--	53	0.0100	53
Acenaphthylene	208-96-8	--	--	0.0100	--
Anthracene	120-12-7	--	180	0.0100	180
Benzo(a)anthracene	56-55-3	--	0.012	0.0100	0.012
Benzo(a)pyrene	50-32-8	0.2	0.0034	0.0100	0.0034
Benzo(b)fluoranthene	205-99-2	--	0.034	0.0100	0.034
Benzo(g,h,i)perylene	191-24-2	--	--	0.0100	--
Benzo(k)fluoranthene	207-08-9	--	0.34	0.0100	0.34
Chrysene	218-01-9	--	3.4	0.0100	3.4
Dibenzo(a,h)anthracene	53-70-3	--	0.0034	0.0100	0.0034
Fluoranthene	206-44-0	--	80	0.0100	80
Fluorene	86-73-7	--	29	0.0100	29
Indeno(1,2,3-c,d)pyrene	193-39-5	--	0.034	0.0100	0.034
Naphthalene	91-20-3	--	0.17	0.0100	0.17
Phenanthrene	85-01-8	--	--	0.0100	--
Pyrene	129-00-0	--	12	0.0100	12
Total Benzofluoranthenes (b,j,k)	--	--	--	--	--
Total HPAH	--	--	--	--	--
Total LPAH	--	--	--	--	--
Total PAH	--	--	--	--	--
Polychlorinated Biphenyls (PCBs) (ug/L)					
Aroclor 1016	12674-11-2	--	0.14	1.0	0.14
Aroclor 1221	11104-28-2	--	0.0047	1.0	0.0047
Aroclor 1232	11141-16-5	--	0.0047	1.0	0.0047
Aroclor 1242	53469-21-9	--	0.0078	1.0	0.0078
Aroclor 1248	12672-29-6	--	0.0078	1.0	0.0078
Aroclor 1254	11097-69-1	--	0.0078	1.0	0.0078
Aroclor 1260	11096-82-5	--	0.0078	1.0	0.0078
Total PCB Aroclors	1336-36-3	--	0.044	--	0.044

Notes:

Compounds frequently associated with MGP-operations.

'--' indicates not available

CAS = Chemical Abstract Services

EPA = U. S. Environmental Protection Agency

L = liter

MCL = maximum contaminant level

mg = miligram

MGP = manufactured gas plant

ng = nanogram

PRG = preliminary remediation goal

RSL = regional screening level

ug = microgram

References:

EPA, 2016. EPA Regional Screening Levels. May 2016. Available from: <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016>

Table 3-6 - Development of Initial PRGs for Sediment
Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	SMS Marine Sediment Cleanup Objective (SCO ¹ /LAET ²)	SMS Marine Cleanup Screening Level (CSL ¹ /2LAET ²)	EPA Region 5 RCRA Sediment Ecological Screening Levels	EPA Region 3 BTAG Marine Sediment Screening Benchmarks	Effects Range-Low (ERL)	Effects Range-Median (ERM)	Initial PRGs used for Data Screening ³
		DOE, 2013	DOE, 2013	EPA, 2003	EPA, 2006	Long et al., 1995	Long et al., 1995	
Alkane Isomers (ug/kg)								
n-Hexane (C6)	110-54-3	--	--	--	39.60	--	--	39.6
Conventionals (mg/kg)								
Cyanide, WAD	57-12-5	--	--	--	0.1	--	--	0.1
Cyanide, total	57-12-5	--	--	0.0001	--	--	--	0.0001
Sulfide	18496-25-8	--	--	--	130	--	--	130
Metals (mg/kg)								
Antimony	7440-36-0	--	--	--	2	--	--	2
Arsenic	7440-38-2	57	93	9.79	7.24	8.2	70	57
Beryllium	7440-41-7	--	--	--	--	--	--	--
Cadmium	7440-43-9	5.1	6.7	0.99	0.68	1.2	9.6	5.1
Chromium	7440-47-3	260	270	43.4	52.3	81	370	260
Chromium III	16065-83-1	--	--	--	--	--	--	--
Chromium VI	18540-29-9	--	--	--	--	--	--	--
Copper	7440-50-8	390	390	31.6	18.7	34	270	390
Lead	7439-92-1	450	530	35.8	30.2	46.7	218	450
Mercury	7439-97-6	0.41	0.59	0.174	0.13	0.15	0.71	0.41
Nickel	7440-02-0	--	--	22.7	15.9	20.9	51.6	20.9
Selenium	7782-49-2	--	--	--	2	--	--	2
Silver	7440-22-4	6.1	6.1	0.5	0.73	1	3.7	6.1
Thallium	7440-28-0	--	--	--	--	--	--	--
Zinc	7440-66-6	410	960	121	124	150	410	410
Metals, Organic (ug/kg)								
Tributyltin	688-73-3	--	--	--	--	--	--	--
Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg)								
1-Methylnaphthalene	90-12-0	--	--	--	--	--	--	--
2-Methylnaphthalene	91-57-6	670	670	20.2	20.2	70	670	670
Acenaphthene	83-32-9	500	500	6.71	6.71	16	500	500
Acenaphthylene	208-96-8	1300	1300	5.87	5.87	44	640	1300
Anthracene	120-12-7	960	960	57.2	46.9	85.3	1100	960
Benzo(a)anthracene	56-55-3	1300	1600	108	74.8	261	1600	1300
Benzo(a)pyrene	50-32-8	1600	1600	150	88.8	430	1600	1600
Benzo(b)fluoranthene	205-99-2	--	--	10400	--	--	--	10400
Benzo(b,k)fluoranthene	--	--	--	--	27.2	--	--	27.2
Benzo(g,h,i)perylene	191-24-2	670	720	170	170	--	--	670
Benzo(j)fluoranthene	205-82-3	--	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	--	--	240	240	--	--	240
Chrysene	218-01-9	1400	2800	166	108	384	2800	1400
Dibenzo(a,h)anthracene	53-70-3	230	230	33	6.22	63.4	260	230
Fluoranthene	206-44-0	1700	2500	423	113	600	5100	1700
Fluorene	86-73-7	540	540	77.4	21.2	19	540	540
Indeno(1,2,3-c,d)pyrene	193-39-5	600	690	200	17	--	--	600
Naphthalene	91-20-3	2100	2100	176	34.6	160	2100	2100
Phenanthrene	85-01-8	1500	1500	204	86.7	240	1500	1500
Pyrene	129-00-0	2600	3300	195	153	665	2600	2600
Total Benzofluoranthenes (b,j,k)	--	3200	3600	--	--	--	--	3200
Total HPAH	--	12000	17000	--	655	1700	9600	12000
Total LPAH	--	5200	5200	--	312	552	3160	5200
Total PAH	--	--	--	--	2900	4022	44792	4022
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg-OC)								
2-Methylnaphthalene	91-57-6	38	64	--	--	--	--	38
Acenaphthene	83-32-9	16	57	--	--	--	--	16
Acenaphthylene	208-96-8	66	66	--	--	--	--	66
Anthracene	120-12-7	220	1200	--	--	--	--	220
Benzo(a)anthracene	56-55-3	110	270	--	--	--	--	110
Benzo(a)pyrene	50-32-8	99	210	--	--	--	--	99
Benzo(g,h,i)perylene	191-24-2	31	78	--	--	--	--	31
Chrysene	218-01-9	110	460	--	--	--	--	110
Dibenzo(a,h)anthracene	53-70-3	12	33	--	--	--	--	12
Fluoranthene	206-44-0	160	1200	--	--	--	--	160
Fluorene	86-73-7	23	79	--	--	--	--	23
Indeno(1,2,3-c,d)pyrene	193-39-5	34	88	--	--	--	--	34
Naphthalene	91-20-3	99	170	--	--	--	--	99
Phenanthrene	85-01-8	100	480	--	--	--	--	100
Pyrene	129-00-0	1000	1400	--	--	--	--	1000
Total Benzofluoranthenes (b,j,k)	--	230	450	--	--	--	--	230
Total HPAH	--	960	5300	--	--	--	--	960
Total LPAH	--	370	780	--	--	--	--	370
Polychlorinated Biphenyls (PCBs) (ug/kg)								
Aroclor 1016	12674-11-2	--	--	--	--	--	--	--
Aroclor 1221	11104-28-2	--	--	--	--	--	--	--
Aroclor 1232	11141-16-5	--	--	--	--	--	--	--
Aroclor 1242	53469-21-9	--	--	--	--	--	--	--
Aroclor 1248	12672-29-6	--	--	--	--	--	--	--
Aroclor 1254	11097-69-1	--	--	--	63.3	--	--	63.3
Aroclor 1260	11096-82-5	--	--	--	--	--	--	--
Aroclor 1262	37324-23-5	--	--	--	--	--	--	--
Aroclor 1268	11100-14-4	--	--	--	--	--	--	--
Total PCB Aroclors	--	130	1000	59.8	40	22.7	180	130
Polychlorinated Biphenyls (PCBs) (mg/kg-OC)								
Total PCB Aroclors	--	12	65	--	--	--	--	12
Semivolatile Organic Compounds (SVOCs)(ug/kg)								
1,2,4,5-Tetrachlorobenzene	95-94-3	--	--	1252	47000	--	--	47000
1,2,4-Trichlorobenzene	120-82-1	31	51	5062	473	--	--	31
1,2-Dichlorobenzene	95-50-1	35	50	294	989	--	--	35
1,3-Dichlorobenzene	541-73-1	--	--	1315	842	--	--	842
1,4-Dichlorobenzene	106-46-7	110	110	318	460	--	--	110
2,2'-Oxybis (1-chloropropane)	108-60-1	--	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	58-90-2	--	--	129	284	--	--	284
2,4,5-Trichlorophenol	95-95-4	--	--	--	819	--	--	819
2,4,6-Trichlorophenol	88-06-2	--	--	208	2650	--	--	2650

Table 3-6 - Development of Initial PRGs for Sediment
Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	SMS Marine Sediment Cleanup Objective (SCO ¹ /LAET ²)	SMS Marine Cleanup Screening Level (CSL ¹ /2LAET ²)	EPA Region 5 RCRA Sediment Ecological Screening Levels	EPA Region 3 BTAG Marine Sediment Screening Benchmarks	Effects Range-Low (ERL)	Effects Range-Median (ERM)	Initial PRGs used for Data Screening ³
		DOE, 2013	DOE, 2013	EPA, 2003	EPA, 2006	Long et al., 1995	Long et al., 1995	
2,4-Dichlorophenol	120-83-2	--	--	81.7	117	--	--	117
2,4-Dimethylphenol	105-67-9	29	29	304	29	--	--	29
2,4-Dinitrophenol	51-28-5	--	--	6.21	--	--	--	6.21
2,4-Dinitrotoluene	121-14-2	--	--	14.4	41.6	--	--	41.6
2,6-Dinitrotoluene	606-20-2	--	--	39.8	--	--	--	39.8
2-Chloronaphthalene	91-58-7	--	--	417	--	--	--	417
2-Chlorophenol	95-57-8	--	--	31.9	344	--	--	344
2-Methylphenol (o-Cresol)	95-48-7	63	63	55.4	--	--	--	63
2-Nitroaniline	88-74-4	--	--	--	--	--	--	--
2-Nitrophenol	88-75-5	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	91-94-1	--	--	127	2060	--	--	2060
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	1319-77-3	--	--	--	--	--	--	--
3-Methylphenol (m-Cresol)	108-39-4	--	--	52.4	--	--	--	52.4
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--
4-Bromophenyl-phenyl ether	101-55-3	--	--	1550	1230	--	--	1230
4-Chloro-3-methylphenol	59-50-7	--	--	388	--	--	--	388
4-Chloroaniline	106-47-8	--	--	146	--	--	--	146
4-Methylphenol (p-Cresol)	106-44-5	670	670	20.2	670	--	--	670
4-Nitroaniline	100-01-6	--	--	--	--	--	--	--
4-Nitrophenol	100-02-7	--	--	13.3	--	--	--	13.3
Acetophenone	98-86-2	--	--	--	--	--	--	--
Aniline	62-53-3	--	--	0.31	--	--	--	0.31
Atrazine	1912-24-9	--	--	--	6.62	--	--	6.62
Benzaldehyde	100-52-7	--	--	--	--	--	--	--
Benzidine	92-87-5	--	--	--	--	--	--	--
Benzoic acid	65-85-0	650	650	--	650	--	--	650
Benzyl alcohol	100-51-6	57	73	1.04	--	--	--	57
Biphenyl (1,1'-Biphenyl)	92-52-4	--	--	--	1220	--	--	1220
bis(2-Chloroethoxy)methane	111-91-1	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	111-44-4	--	--	3520	--	--	--	3520
bis(2-Ethylhexyl)phthalate	117-81-7	1300	3100	182	182	--	--	1300
Butylbenzyl phthalate	85-68-7	63	900	1970	16800	--	--	63
Caprolactam	105-60-2	--	--	--	--	--	--	--
Dibenzofuran	132-64-9	540	540	449	7300	--	--	540
Diethyl phthalate	84-66-2	200	1200	295	218	--	--	200
Dimethyl phthalate	131-11-3	71	160	--	--	--	--	71
Di-n-butyl phthalate	84-74-2	1400	5100	1114	1160	--	--	1400
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	534-52-1	--	--	104	--	--	--	104
Di-n-octyl phthalate	117-84-0	6200	6200	40600	--	--	--	6200
Hexachlorobenzene	118-74-1	22	70	20	20	--	--	22
Hexachlorocyclopentadiene	77-47-4	--	--	901	139	--	--	139
Hexachloroethane	67-72-1	--	--	584	804	--	--	804
Isophorone	78-59-1	--	--	432	--	--	--	432
Nitrobenzene	98-95-3	--	--	145	--	--	--	145
n-Nitrosodimethylamine	62-75-9	--	--	--	--	--	--	--
n-Nitrosodi-n-propylamine	621-64-7	--	--	--	--	--	--	--
n-Nitrosodiphenylamine	86-30-6	28	40	--	422000	--	--	28
Pentachlorophenol	87-86-5	360	690	23000	7970	--	--	360
Phenol	108-95-2	420	1200	49.1	420	--	--	420
Semivolatile Organic Compounds (SVOCs) (mg/kg-OC)								
1,2,4-Trichlorobenzene	120-82-1	0.81	1.8	--	--	--	--	0.81
1,2-Dichlorobenzene	95-50-1	2.3	2.3	--	--	--	--	2.3
1,4-Dichlorobenzene	106-46-7	3.1	9	--	--	--	--	3.1
bis(2-Ethylhexyl)phthalate	117-81-7	47	78	--	--	--	--	47
Butylbenzyl phthalate	85-68-7	4.9	64	--	--	--	--	4.9
Dibenzofuran	132-64-9	15	58	--	--	--	--	15
Diethyl phthalate	84-66-2	61	110	--	--	--	--	61
Dimethyl phthalate	131-11-3	53	53	--	--	--	--	53
Di-n-butyl phthalate	84-74-2	220	1700	--	--	--	--	220
Di-n-octyl phthalate	117-84-0	58	4500	--	--	--	--	58
Hexachlorobenzene	118-74-1	0.38	2.3	--	--	--	--	0.38
n-Nitrosodiphenylamine	86-30-6	11	11	--	--	--	--	11
Volatile Organic Compounds (VOCs) (ug/kg)								
1,1,1,2-Tetrachloroethane	630-20-6	--	--	--	--	--	--	--
1,1,1-Trichloroethane	71-55-6	--	--	213	856	--	--	856
1,1,2,2-Tetrachloroethane	79-34-5	--	--	850	202	--	--	202
1,1,2-Trichloroethane	79-00-5	--	--	518	570	--	--	570
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	--	--	0.575	--	--	--	0.575
1,1-Dichloroethene	75-35-4	--	--	19.4	2780	--	--	2780
1,2,3-Trichlorobenzene	87-61-6	--	--	--	858	--	--	858
1,2,3-Trichloropropane	96-18-4	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	96-12-8	--	--	--	--	--	--	--
1,2-Dichloroethane	107-06-2	--	--	260	--	--	--	260
1,2-Dichloroethene, cis-	156-59-2	--	--	--	--	--	--	--
1,2-Dichloroethene, trans-	156-60-5	--	--	654	1050	--	--	1050
1,2-Dichloropropane	78-87-5	--	--	333	--	--	--	333
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	--	--	--	--	--	--	--
1,3-Dichloropropane	142-28-9	--	--	--	--	--	--	--
1,3-Dichloropropene, cis-	10061-01-5	--	--	--	--	--	--	--
1,3-Dichloropropene, trans-	10061-02-6	--	--	--	--	--	--	--
1,4-Dichloro-2-butene, trans-	110-57-6	--	--	--	--	--	--	--
1,4-Dioxane	123-91-1	--	--	119	--	--	--	119
2-Butanone (MEK)	78-93-3	--	--	42.4	--	--	--	42.4
2-Chlorotoluene	95-49-8	--	--	--	--	--	--	--
2-Hexanone (Methyl butyl ketone)	591-78-6	--	--	58.2	--	--	--	58.2
4-Chlorotoluene	106-43-4	--	--	--	--	--	--	--
4-Isopropyltoluene (4-Cymene)	99-87-6	--	--	--	--	--	--	--
Acetone	67-64-1	--	--	9.9	--	--	--	9.9
Acrolein	107-02-8	--	--	0.00152	--	--	--	0.00152
Acrylonitrile	107-13-1	--	--	1.2	--	--	--	1.2

Table 3-6
Final RI/FS Work Plan
Page 2 of 3

Table 3-6 - Development of Initial PRGs for Sediment
Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	SMS Marine Sediment Cleanup Objective (SCO ¹ /LAET ²)	SMS Marine Cleanup Screening Level (CSL ¹ /2LAET ²)	EPA Region 5 RCRA Sediment Ecological Screening Levels	EPA Region 3 BTAG Marine Sediment Screening Benchmarks	Effects Range-Low (ERL)	Effects Range-Median (ERM)	Initial PRGs used for Data Screening ³
		DOE, 2013	DOE, 2013	EPA, 2003	EPA, 2006	Long et al., 1995	Long et al., 1995	
Benzene	71-43-2	--	--	142	137	--	--	137
Bromobenzene	108-86-1	--	--	--	--	--	--	--
Bromochloromethane	74-97-5	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	--	--	--	--	--	--	--
Bromoform (Tribromomethane)	75-25-2	--	--	492	1310	--	--	1310
Bromomethane (Methyl bromide)	74-83-9	--	--	1.37	--	--	--	1.37
Carbon disulfide	75-15-0	--	--	23.9	0.851	--	--	0.851
Carbon tetrachloride (Tetrachloromethane)	56-23-5	--	--	1450	7240	--	--	7240
Chlorobenzene	108-90-7	--	--	291	162	--	--	162
Chloroethane	75-00-3	--	--	--	--	--	--	--
Chloroform	67-66-3	--	--	121	--	--	--	121
Chloromethane	74-87-3	--	--	--	--	--	--	--
Cyclohexane	110-82-7	--	--	--	--	--	--	--
Dibromochloromethane	124-48-1	--	--	--	--	--	--	--
Dibromomethane	74-95-3	--	--	--	--	--	--	--
Dichlorodifluoromethane	75-71-8	--	--	--	--	--	--	--
Dichloromethane (Methylene chloride)	75-09-2	--	--	159	--	--	--	159
Ethylbenzene	100-41-4	--	--	175	305	--	--	305
Ethylene dibromide (1,2-Dibromoethane)	106-93-4	--	--	--	--	--	--	--
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87-68-3	11	120	26.5	--	--	--	11
Isopropylbenzene (Cumene)	98-82-8	--	--	--	86	--	--	86
Methyl acetate	79-20-9	--	--	--	--	--	--	--
Methyl iodide (Iodomethane)	74-88-4	--	--	--	--	--	--	--
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	108-10-1	--	--	25.1	--	--	--	25.1
Methyl tert-butyl ether (MTBE)	1634-04-4	--	--	--	--	--	--	--
n-Butylbenzene	104-51-8	--	--	--	--	--	--	--
n-Propylbenzene	103-65-1	--	--	--	--	--	--	--
o-Xylene	95-47-6	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	--	--	--	--	--	--	--
Styrene	100-42-5	--	--	254	7070	--	--	7070
tert-Butylbenzene	98-06-6	--	--	--	--	--	--	--
Tetrachloroethene (PCE)	127-18-4	--	--	990	190	--	--	190
Toluene	108-88-3	--	--	1220	1090	--	--	1090
Total xylene (reported, not calculated)	1330-20-7	--	--	433	--	--	--	433
Total Xylene	--	--	--	433	--	--	--	433
Trichloroethene (TCE)	79-01-6	--	--	112	8950	--	--	8950
Trichlorofluoromethane (Fluorotrichloromethane)	75-69-4	--	--	--	--	--	--	--
Vinyl acetate	108-05-4	--	--	13	--	--	--	13
Vinyl chloride	75-01-4	--	--	202	--	--	--	202
Volatile Organic Compounds (VOCs) (mg/kg-OC)								
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87-68-3	3.9	6.2	--	--	--	--	3.9

Notes:

Compounds frequently associated with MGP-operations

'-- indicates not available

1 = This criteria will be used when total organic carbon (TOC) is between 0.5% to 5%.

2 = This criteria will be used when total organic carbon (TOC) is less than 0.5% or greater than 5%.

3 = Site-specific fish and shellfish consumption based PRGs have not yet been developed. The fish and shellfish based PRGs will be developed in consultation with EPA and the Suquamish Tribe as part of this RI/FS Work Plan implementation.

2LAET = Second Lowest Apparent Effects Threshold

BTAG = Biological Technical Assistance Group

CAS = Chemical Abstract Services

CSL = Cleanup Screening Level

DOE = Washington Department of Ecology

EPA = United States Environmental Protection Agency

kg = kilogram

LAET = Lowest Apparent Effects Threshold

mg = milligram

MGP = Manufactured Gas Plant

ng = nanogram

OC = organic carbon

PRG = preliminary remediation goal

RCRA = Resource Conservation and Recovery Act

SCO = Sediment Cleanup Objective

SMS = Sediment Management Standards

ug = microgram

References:

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Table 3-7 - Development of Initial PRGs for Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte		ARARs				Other Screening Benchmark Sources		Initial PRGs used for Data Screening
		National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
	CAS Number	EPA, 2013	EPA, 2013	EPA, 2013	EPA/Ecology,2016	EPA, 2006	EPA, 2003	
Alkane Isomers (ug/L)								
n-Hexane (C6)	110-54-3	--	--	--	--	0.58	--	0.58
Conventionals (mg/L)								
Cyanide, free	57-12-5	0.001	0.001	--	--	0.001	--	0.001
Cyanide, total	57-12-5	--	--	0.14	0.10	--	0.0052	0.10
Sulfide	18496-25-8	--	--	--	--	--	--	--
Metals (ug/L)								
Antimony	7440-36-0	--	--	640	90	500	80	90
Arsenic	7440-38-2	36	69	0.14	0.14	12.5 (a)	148	0.14
Beryllium	7440-41-7	--	--	--	--	0.66	3.6	0.66
Cadmium	7440-43-9	8.8	40	--	--	0.12 (a)	0.15	8.8
Chromium	7440-47-3	--	--	--	--	57.5	42	42
Chromium III	16065-83-1	--	--	--	--	56 (a)	--	56
Chromium VI	18540-29-9	50	1100	--	--	1.5 (a)	--	50
Copper	7440-50-8	3.1	4.8	--	--	3.1	1.58	3.1
Lead	7439-92-1	8.1	210	--	--	8.1	1.17	8.1
Mercury	7439-97-6	0.94	1.8	--		0.016 (a)	0.0013	0.94
Nickel	7440-02-0	8.2	74	4600	100	8.2	28.9	8.2
Selenium	7782-49-2	71	290	4200	200	71	5	71
Silver	7440-22-4	--	1.9	--	--	0.23	0.12	1.9
Thallium	7440-28-0	--	--	0.47	6.3	21.3	10	6.3
Zinc	7440-66-6	81	90	26000	1000	81	65.7	81
Metals, Organic (ug/L)								
Tributyltin	688-73-3	0.0074	0.42	--	--	0.001 (a)	--	0.0074
Polycyclic Aromatic Hydrocarbons (PAHs) (ug/L)								
1-Methylnaphthalene	90-12-0	--	--	--	--	2.1	--	2.1
2-Methylnaphthalene	91-57-6	--	--	--	--	4.2	330	4.2
Acenaphthene	83-32-9	--	--	990	30	6.6	38	30
Acenaphthylene	208-96-8	--	--	--	--	--	4840	4840
Anthracene	120-12-7	--	--	40000	100	0.18	0.035	100
Benzo(a)anthracene	56-55-3	--	--	0.018	0.00016	0.018	0.025	0.00016
Benzo(a)pyrene	50-32-8	--	--	0.018	0.000016	0.015	0.014	0.000016
Benzo(b)fluoranthene	205-99-2	--	--	0.018	0.00016	--	9.07	0.00016
Benzo(b,k)fluoranthene	--	--	--	--	0.0016	--	--	0.0016
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	7.64	7.64
Benzo(j)fluoranthene	205-82-3	--	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	--	--	0.018	0.0016	--	--	0.0016
Chrysene	218-01-9	--	--	0.018	0.016	--	--	0.016

Table 3-7 - Development of Initial PRGs for Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte			ARARs				Other Screening Benchmark Sources		Initial PRGs used for Data Screening
			National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
		CAS Number	EPA, 2013	EPA, 2013	EPA, 2013	EPA/Ecology,2016	EPA, 2006	EPA, 2003	
Dibenzo(a,h)anthracene		53-70-3	--	--	0.018	0.000016	--	--	0.000016
Fluoranthene		206-44-0	--	--	140	6	1.6	1.9	6
Fluorene		86-73-7	--	--	5300	10	2.5	19	10
Indeno(1,2,3-c,d)pyrene		193-39-5	--	--	0.018	0.00016	--	4.31	0.00016
Naphthalene		91-20-3	--	--	--	--	1.4 (a)	13	1.4
Phenanthrene		85-01-8	--	--	--	--	1.5	3.6	1.5
Pyrene		129-00-0	--	--	4000	8	0.24	0.3	8
Total Benzofluoranthenes (b,j,k)		--	--	--	--	--	--	--	--
Total HPAH		--	--	--	--	--	--	--	--
Total LPAH		--	--	--	--	--	--	--	--
Total PAH		--	--	--	--	--	--	--	--
Polychlorinated Biphenyls (PCBs) (ug/L)									
Aroclor 1016		12674-11-2	--	--	--	--	--	--	--
Aroclor 1221		11104-28-2	--	--	--	--	--	--	--
Aroclor 1232		11141-16-5	--	--	--	--	--	--	--
Aroclor 1242		53469-21-9	--	--	--	--	--	--	--
Aroclor 1248		12672-29-6	--	--	--	--	--	--	--
Aroclor 1254		11097-69-1	--	--	--	--	--	--	--
Aroclor 1260		11096-82-5	--	--	--	--	--	--	-
Aroclor 1262		37324-23-5	--	--	--	--	--	--	--
Aroclor 1268		11100-14-4	--	--	--	--	--	--	--
Total PCB			--	--	--	0.000007	--	--	0.000007
Semivolatile Organic Carbons (SVOCs) (ug/L)									
1,2,4,5-Tetrachlorobenzene		95-94-3	--	--	1.10	--	129	3	1.10
1,2,4-Trichlorobenzene		120-82-1	--	--	70	0.037	5.4 (a)	30	0.037
1,2-Dichlorobenzene		95-50-1	--	--	1300	800	42 (a)	14	800
1,3-Dichlorobenzene		541-73-1	--	--	960	2	28.5	38	2
1,4-Dichlorobenzene		106-46-7	--	--	190	200	19.9	9.4	200
2,2'-Oxybis (1-chloropropane)		108-60-1	--	--	65000	900	--	--	900
2,3,4,6-Tetrachlorophenol		58-90-2	--	--	--	--	1.2	1.2	1.2
2,4,5-Trichlorophenol		95-95-4	--	--	--	--	12	--	12
2,4,6-Trichlorophenol		88-06-2	--	--	2.4	0.28	61	4.9	0.28
2,4-Dichlorophenol		120-83-2	--	--	290	10	11	11	10
2,4-Dimethylphenol		105-67-9	--	--	850	97	--	100	97
2,4-Dinitrophenol		51-28-5	--	--	5300	100	48.5	19	100
2,4-Dinitrotoluene		121-14-2	--	--	3.4	0.18	44	44	0.18
2,6-Dinitrotoluene		606-20-2	--	--	--	--	81	81	81
2-Chloronaphthalene		91-58-7	--	--	1600	100	--	0.396	100

Table 3-7 - Development of Initial PRGs for Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	ARARs				Other Screening Benchmark Sources		Initial PRGs used for Data Screening
		National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
		EPA, 2013	EPA, 2013	EPA, 2013	EPA/Ecology,2016	EPA, 2006	EPA, 2003	
2-Chlorophenol	95-57-8	--	--	150	17	265	24	17
2-Methylphenol (o-Cresol)	95-48-7	--	--	--	--	1020	67	67
2-Nitroaniline	88-74-4	--	--	--	--	--	--	--
2-Nitrophenol	88-75-5	--	--	--	--	2940	--	2940
3,3'-Dichlorobenzidine	91-94-1	--	--	0.03	0.0033	73	4.5	0.0033
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	1319-77-3	--	--	--	--	--	--	--
3-Methylphenol (m-Cresol)	108-39-4	--	--	--	--	--	62	62
3-Nitroaniline	99-09-2	--	--	--	--	--	--	--
4-Bromophenyl-phenyl ether	101-55-3	--	--	--	--	1.5	1.5	1.5
4-Chloro-3-methylphenol	59-50-7	--	--	--	36	--	34.8	36
4-Chloroaniline	106-47-8	--	--	--	--	232	232	232
4-Methylphenol (p-Cresol)	106-44-5	--	--	--	--	543	25	25
4-Nitroaniline	100-01-6	--	--	--	--	--	--	--
4-Nitrophenol	100-02-7	--	--	--	--	71.7	60	60
Acetophenone	98-86-2	--	--	--	--	--	--	--
Aniline	62-53-3	--	--	--	--	2.2	4.1	2.2
Atrazine	1912-24-9	--	--	--	--	1.8	--	1.8
Benzaldehyde	100-52-7	--	--	--	--	--	--	--
Benzidine	92-87-5	--	--	--	0.000023	3.9	--	0.000023
Benzoic acid	65-85-0	--	--	--	--	42	--	42
Benzyl alcohol	100-51-6	--	--	--	--	8.6	8.6	8.6
Biphenyl (1,1'-Biphenyl)	92-52-4	--	--	--	--	14	--	14
bis(2-Chloroethoxy)methane	111-91-1	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	111-44-4	--	--	0.53	0.06	--	19000	0.06
bis(2-Ethylhexyl)phthalate	117-81-7	--	--	2.2	0.046	16	0.3	0.046
Butylbenzyl phthalate	85-68-7	--	--	1900	0.013	29.4	23	0.013
Caprolactam	105-60-2	--	--	--	--	--	--	--
Dibenzofuran	132-64-9	--	--	--	--	65	4	4
Diethyl phthalate	84-66-2	--	--	44000	200	75.9	110	200
Dimethyl phthalate	131-11-3	--	--	1100000	600	580	--	600
Di-n-butyl phthalate	84-74-2	--	--	4500	8	3.4	9.7	8
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	534-52-1	--	--	280	7	--	23	7
Di-n-octyl phthalate	117-84-0	--	--	--	--	22	30	22
Hexachlorobenzene	118-74-1	--	--	0.00029	0.000005	0.0003	0.0003	0.000005
Hexachlorocyclopentadiene	77-47-4	--	--	1100	1	0.07	77	1
Hexachloroethane	67-72-1	--	--	3.3	0.02	9.4	8	0.02
Isophorone	78-59-1	--	--	960	110	129	920	110
Nitrobenzene	98-95-3	--	--	690	100	66.8	220	100

Table 3-7 - Development of Initial PRGs for Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte	CAS Number	ARARs				Other Screening Benchmark Sources		Initial PRGs used for Data Screening
		National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
		EPA, 2013	EPA, 2013	EPA, 2013	EPA/Ecology,2016	EPA, 2006	EPA, 2003	
n-Nitrosodimethylamine	62-75-9	--	--	--	0.34	330000	--	0.34
n-Nitrosodi-n-propylamine	621-64-7	--	--	0.51	0.058	120	--	0.058
n-Nitrosodiphenylamine	86-30-6	--	--	6	0.69	33000	--	0.69
Pentachlorophenol	87-86-5	7.9	13	3	0.002	7.9	4	0.002
Phenol	108-95-2	--	--	860000	70000	58	180	70000
Volatile Organic Carbons (VOCs) (ug/L)								
1,1,1-Trichloroethane	71-55-6	--	--	--	50000	312	76	50000
1,1,1,2-Tetrachloroethane	630-20-6	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	--	--	4	0.3	90.2	380	0.3
1,1,2-Trichloroethane	79-00-5	--	--	16	0.9	550	500	0.9
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	--	--	--	--	47	47	47
1,1-Dichloroethene	75-35-4	--	--	7100	4000	2240	65	4000
1,2,3-Trichlorobenzene	87-61-6	--	--	--	--	8	--	8
1,2,3-Trichloropropane	96-18-4	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	19	--	19
1,2-Dibromo-3-chloropropane	96-12-8	--	--	--	--	--	--	--
1,2-Dichloroethane	107-06-2	--	--	37	73	1130	910	73
1,2-Dichloroethene, cis-	156-59-2	--	--	--	--	--	--	--
1,2-Dichloroethene, trans-	156-60-5	--	--	10000	1000	970	970	1000
1,2-Dichloropropane	78-87-5	--	--	15	3.1	2400	360	3.1
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8	--	--	--	--	71	--	71
1,3-Dichloropropane	142-28-9	--	--	--	--	--	--	--
1,3-Dichloropropene, cis-	10061-01-5	--	--	21	1.2	--	--	1.2 (b)
1,3-Dichloropropene, trans-	10061-02-6	--	--	21	1.2	--	--	1.2 (b)
1,4-Dichloro-2-butene, trans-	110-57-6	--	--	--	--	--	--	--
1,4-Dioxane	123-91-1	--	--	--	--	--	22000	22000
2-Butanone (MEK)	78-93-3	--	--	--	--	14000	2200	2200
2-Chlorotoluene	95-49-8	--	--	--	--	--	--	--
2-Hexanone (Methyl butyl ketone)	591-78-6	--	--	--	--	99	99	99
4-Chlorotoluene	106-43-4	--	--	--	--	--	--	--
4-Isopropyltoluene (4-Cymene)	99-87-6	--	--	--	--	85	--	85
Acetone	67-64-1	--	--	--	--	564000	1700	1700
Acrolein	107-02-8	--	--	--	1.1	0.55	0.19	1.1
Acrylonitrile	107-13-1	--	--	--	0.028	581	66	0.028
Benzene	71-43-2	--	--	51.00	1.6	110 (a)	114	1.6
Bromobenzene	108-86-1	--	--	--	--	--	--	--
Bromochloromethane	74-97-5	--	--	--	--	--	--	--

Table 3-7 - Development of Initial PRGs for Surface Water

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			National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
Bromodichloromethane		75-27-4	--	--	17	2.8	--	--	2.8
Bromoform (Tribromomethane)		75-25-2	--	--	140	12	640	230	12
Bromomethane (Methyl bromide)		74-83-9	--	--	1500	2400	120	16	2400
Carbon disulfide		75-15-0	--	--	--	--	0.92	15	0.92
Carbon tetrachloride (Tetrachloromethane)		56-23-5	--	--	1.6	0.35	1500	240	0.35
Chlorobenzene		108-90-7	--	--	1600	200	25 (a)	47	200
Chloroethane		75-00-3	--	--	--	--	--	--	--
Chloroform		67-66-3	--	--	470	600	815	140	600
Chloromethane		74-87-3	--	--	--	--	2700	--	2700
Cyclohexane		110-82-7	--	--	--	--	--	--	--
Dibromochloromethane		124-48-1	--	--	13	2.2	--	--	2.2
Dibromomethane		74-95-3	--	--	--	--	--	--	--
Dichlorodifluoromethane		75-71-8	--	--	--	--	--	--	--
Dichloromethane (Methylene chloride)		75-09-2	--	--	590	100	2560	940	100
Ethylbenzene		100-41-4	--	--	2100	31	25 (a)	14	31
Ethylene dibromide (1,2-Dibromoethane)		106-93-4	--	--	--	--	--	--	--
Hexachlorobutadiene (Hexachloro-1,3-butadiene)		87-68-3	--	--	18	0.01	0.3	0.053	0.01
Isopropylbenzene (Cumene)		98-82-8	--	--	--	--	2.6	--	2.6
Methyl acetate		79-20-9	--	--	--	--	--	--	--
Methyl iodide (Iodomethane)		74-88-4	--	--	--	--	--	--	--
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))		108-10-1	--	--	--	--	123000	170	170
Methyl tert-butyl ether (MTBE)		1634-04-4	--	--	--	--	11070	--	11070
n-Butylbenzene		104-51-8	--	--	--	--	--	--	--
n-Propylbenzene		103-65-1	--	--	--	--	128	--	128
o-Xylene		95-47-6	--	--	--	--	--	--	--
sec-Butylbenzene		135-98-8	--	--	--	--	--	--	--
Styrene		100-42-5	--	--	--	--	910	32	32
tert-Butylbenzene		98-06-6	--	--	--	--	--	--	--
Tetrachloroethene (PCE)		127-18-4	--	--	3.3	2.9	45	45	2.9
Toluene		108-88-3	--	--	15000	130	215 (a)	253	130
Total xylene (reported, not calculated)		1330-20-7	--	--	--	--	--	--	--
Total Xylene		--	--	--	--	--	19	27	19
Trichloroethene (TCE)		79-01-6	--	--	30.00	0.7	21	47	0.7
Trichlorofluoromethane (Fluorotrichloromethane)		75-69-4	--	--	--	--	--	--	--
Vinyl acetate		108-05-4	--	--	--	--	16	248	16
Vinyl chloride		75-01-4	--	--	2.40	0.18	930	930	0.18

Table 3-7 - Development of Initial PRGs for Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte		ARARs				Other Screening Benchmark Sources		Initial PRGs used for Data Screening
		National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CCC (chronic) ¹	National Recommended Water Quality Criteria - Aquatic Life Criteria - Saltwater CMC (acute) ¹	National Recommended Water Quality Criteria - Human Health for the Consumption of Organisms	EPA 2016 CWA- Effective Human Health Criteria Applicable to Washington (Organism Only)	EPA Region 3 BTAG Marine Water Screening Benchmarks	EPA Region 5 RCRA - Ecological Screening Levels - Water	
	CAS Number	EPA, 2013	EPA, 2013	EPA, 2013	EPA/Ecology,2016	EPA, 2006	EPA, 2003	

Notes:

Compounds frequently associated with MGP-operations

'-- indicates not available

1 = Criteria for metals and methyl mercury are expressed in terms of the dissolved metal in the water column.

(a) = This is a Canadian Water Quality Guideline value and refers to the total concentration in an unfiltered sample.

(b) = 1,3-dichloropropene listed in EPA 2016 but it is not designated to the cis- or trans- isomers. Conservatively, the 1,3-dichloropropene screening value has been applied for initial evaluation.

BTAG = Biological Technical Assistance Group

CAS = Chemical Abstract Services

CCC = Criterion Continuous Concentration

CMC = Criterion Maximum Concentration

CWA = Clean Water Act

EPA = U.S. Environmental Protection Agency

HPAH = high molecular weight PAH

LPAH = low molecular weight PAH

L = liter

mg = milligram

MGP = manufactured gas plant

ng = nanogram

PRG = Preliminary Remediation Goal

RCRA = Resource Conservation and Recovery Act

RSL = regional screening level

µg = microgram

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EPA, 2003. EPA Region 5 Resource Conservation Recovery Act (RCRA) Ecological Screening Levels. August 22, 2003.

EPA, 2006. EPA Region 3 Biological Technical Assistance Group (BTAG) Screening Benchmarks. Marine Sediment Benchmarks. July 2006.

EPA, 2013a. National Recommended Water Quality Criteria. Updated August 22, 2013. Available from: <http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable>.

EPA, 2016. EPAs Partial Approval/Partial Disapproval of Washington's Human Health Water Quality Criteria and Implementation Tools. November 15, 2016. Available from: https://www.epa.gov/sites/production/files/2016-11/documents/epas_partial_approvalpartial_disapproval_wa_hh_wqc_impl_tools_bellon_ltr_enclosures_508c.pdf

Table 3-8 - Summary of Data Quality Review for Existing Site Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Study/Media							
2008 E&E Targeted Brownfields (E&E 2008, E&E 2009)		2010 E&E Removal Action (EPA 2010, AnchorQEA 2011)	1995 Ecology (Ecology 1995)	2007 Geoengineers (Geoengineers 2007a, 2007b)	2008 E&E Targeted Brownfields (E&E 2008, E&E 2009)	2007 Geoengineers (Geoengineers 2007a, 2007b)	2008 E&E Targeted Brownfields (E&E 2008, E&E 2009)
Sediment		Sediment	Soil	Soil	Soil	Groundwater	Groundwater
Work Plan Documentation							
Work Plan (SAP/QAPP)	Detailed QAPP covering multiple pieces of sampling program (soil, groundwater and sediment). Also includes general sediment sampling SOP and data report.	Site-Specific Sampling Plan (SSSP; not reviewed) approved by EPA, finalized after sampling conducted but in field deviations approved by EPA.	None	Work Plan, including site-specific SAP and QAPP, dated June 1, 2007	SQAPP dated March 5, 2008	Work Plan, including site-specific SAP and QAPP, dated June 1, 2007	SQAPP dated March 5, 2008
Collection methods and purpose	Detailed in QAPP. Sampling under EPA Brownfields management, follows EPA procedures. Limited for sediment; to determine if GW migration from upland sources is occurring into the Narrows.	Developed under EPA Superfund Technical Assessment Response Team (START). Determining origin of contamination from 12" exposed drain pipe on Sesko property beach.	Surface soil/sediment samples of suspected contamination based on visual inspection	Purpose to assess soil quality in potential contaminant source areas. Table of rationale for specific boring/sample locations referenced but not included in final work plan.	Judgmental sampling design to determine presence of contamination in areas of concern. Detailed rationale provided in SQAPP.	Purpose to assess groundwater quality in and downgradient of potential contaminant source areas. Table of rationale for specific boring/sample locations referenced but not included in final work plan.	Judgmental sampling design to determine presence of contamination in areas of concern. Detailed rationale provided in SQAPP.
Sample Location and Collection Methods							
Location method, accuracy, and datum.	Location established with GPS coordinates; accuracy not specified. Actual sampling appear to be close/at QAPP locations. Datum not specified.	Location established with GPS coordinates; accuracy not specified. Datum not specified.	Sample locations recorded on rough site sketch. No survey information provided.	Locations provided on scaled site map. Location method unknown. No survey information provided.	Locations provided on scaled site map. Location method unknown. No survey information provided. Note: locations of borings SP01 and SP03 apparently switched on site map, based on boring log information and correlation of chemical data with boring log observations.	Locations provided on scaled site map. Location method unknown. No survey information provided.	Locations provided on scaled site map. Location method unknown. No survey information provided. Note: locations of borings SP01 and SP03 apparently switched on site map, based on boring log information and correlation of chemical data with boring log observations.
Sample depths	0-30cm	0-6 inches	Less than 10 inches	up to 45 feet deep	up to 40 feet deep	15-foot long well screens up to 45 feet deep	Monitoring Wells: 10-foot long well screens up to 45 feet deep. Temporary borings: depth not provided.
Collection method and matrix	Surface sediment. Dedicated stainless steel spoon. Collected at low tide from 5 biased locations targeted to evaluate potential for GW migration based on previous analytical and "on-site observations".	Surface sediment. Dedicated stainless steel spoon. Known areas of sediment deposition within the direct vicinity of the 12: drainpipe, collected below average high tide line.	Hand collection of surface soil/sediment samples	Hollow-stem auger drilling with split-spoon sampling.	Hollow-stem auger drilling with split-spoon sampling.	Report states low-flow sampling with peristaltic pump. Questionable for 30-ft deep groundwater samples.	Monitoring wells sampled using low-flow sampling using electric submersible pump. Methods for sampling temporary boreholes not provided.
Sample collection, processing and handling	Homogenized in dedicated stainless steel bowls (VOC cores taken from sampling locations prior to other sediment collection). Data report includes photographs at each sediment station.	Homogenized in dedicated stainless steel bowls (VOC cores taken from sampling locations prior to other sediment collection). Data report includes photographs at each sediment station.	Collection and handling activities not reported.	Soil samples collected from 8 borings at 5-foot intervals and field screened for contamination. 17 samples collected for sample analysis. VOC samples collected by EPA 5035A. Protocols detailed in SAP.	Soil samples collected from 7 borings at 5-foot intervals and field screened for contamination. 48 samples collected for sample analysis. VOC samples collected by EPA 5035A. Protocols detailed in SAP.	Groundwater samples collected from 8 permanent, developed monitoring wells. Processing and handling protocols detailed in SAP.	Groundwater samples collected from 2 permanent, developed monitoring wells and 4 temporary borings. Processing and handling protocols detailed in SAP.
Holding time, preservation, and chain of custody	Detailed in the QAPP. Chain of custody provided in data report. Holding time and preservation discussed in lab data report.	Chain of custody provided in data report. Holding time and preservation discussed in lab data report.	chain of custody not provided. Laboratory case narrative indicates holding times were within recommended limits.	Requirements detailed in SAP and QAPP. Holding times and preservation were met as documented in data report. Chain of custody provided in data report.	Requirements detailed in SAP and QAPP. Holding times and preservation were met as documented in data report. Chain of custody provided in data report.	Requirements detailed in SAP and QAPP. Holding times and preservation were met as documented in data report. Chain of custody provided in data report.	Requirements detailed in SAP and QAPP. Holding times and preservation were met as documented in data report. Chain of custody provided in data report.
Laboratory Analysis							
Analytical methods are standard or USEPA approved	EPA and NWTPH methods. TPH-Dx, TPH-Dx, VOC, SVOC, TAL metals.	EPA methods. VOC by 8260, SVOC by 8270, static sheen test.	EPA Methods. Metals - EPA200.7, EPA270.2, EPA206.2, EPA279.2, EPA245.5 PAHs - Manchester Modification of SW8270	EPA and NWTPH Methods. TPH - Ecology NWTPH-Gx and NWTPH-Dx VOCs - EPA -8260B SVOCs - EPA 8270 SIM PCBs - EPA 8082 PP metals/chromiumVI - EPA 6000/7000 series TBT - Krone (GC/MS)	TPH - Ecology NWTPH-Gx and NWTPH-Dx VOCs - EPA 8260B SVOCs - EPA 8270C TAL metals - EPA 6000/7000 series	EPA and NWTPH Methods. TPH - Ecology NWTPH-Gx and NWTPH-Dx VOCs - EPA -8260B SVOCs - EPA 8270 SIM PCBs - EPA 8082 PP metals/chromiumVI - EPA 6000/7000 series	EPA and NWTPH Methods. TPH - Ecology NWTPH-Gx and NWTPH-Dx VOCs - EPA 8260B SVOCs - EPA 8270C TAL metals - EPA 6000/7000 series
Detection limits and qualifiers determined based on USEPA guidance	Yes. Detailed in the QAPP. Qualifier identified in laboratory data report.	Yes. Qualifier identified in laboratory data report.	summarized in QA narrative in laboratory data report.	Yes. Detailed in QAPP. Qualifiers identified in laboratory data report.	Yes. Detailed in QAPP. Qualifiers identified in laboratory data report.	Yes. Detailed in QAPP. Qualifiers identified in laboratory data report.	Yes. Detailed in QAPP. Qualifiers identified in laboratory data report.
Measurement instruments and calibration procedures	Detailed in QAPP. Sampling under EPA Brownfields management, follows EPA procedures.	Some detail provided in data validation memo.	Some detail provided in QA narrative in laboratory data report.	Yes. Detailed in QAPP.	Detailed in QAPP. Sampling under EPA Brownfields management, follows EPA procedures.	Yes. Detailed in QAPP.	Detailed in QAPP. Sampling under EPA Brownfields management, follows EPA procedures.
Quality Control and Data Validation							
Field/Lab quality control samples (duplicates, blanks)	Field rinsate and trip blanks (no issues in sediment samples) MS/MSD, serial dilution, internal standards.	Field trip blank.	MS/MSD, LCS	Field duplicate; method blanks, calibration blanks, sample blanks, MS/MSD, and LCS.	Laboratory blanks, rinsate blanks, trip blanks, MS/MSD.	Field duplicate, rinseate blank, and trip blanks; method blanks, calibration blanks, sample blanks, MS/MSD, and LCS.	Laboratory blanks, rinsate blanks, trip blanks, MS/MSD.
Analytical chemistry data must have been validated and qualified consistent with EPA functional guidelines	Data validation conducted. Data validation memo included as Appendix to data report. Procedures also detailed in QAPP.	Data validation conducted. Data validation memo included as Appendix to data report.	QA summary by lab. Compounds with low matrix spike recoveries rejected or "J" qualified.	QA summary by lab.	QA/QC review and data validation documented in data report.	QA summary by lab.	QA/QC review and data validation documented in data report.
Laboratory data reports	Level II Data Package Available.	Level II Data Package Available.	Partial Level II Data Package Available.	Level II Data Package Available	Level II Data Package Available	Level II Data Package Available	Level II Data Package Available

Notes:
COC = chemical of concern
EPA = U.S. Environmental Protection Agency
GC/MS = gas chromatography-mass spectrometry
LCS = laboratory control sample
MS/MSD = matrix spike/matrix spike duplicate
NWTPH = Northwest total petroleum hydrocarbon
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PP = priority pollutant
QA = quality assurance
QAPP = Quality Assurance Project Plan
QC = quality control
SAP = Sampling and Analysis Plan
SOP = standard operating procedure
SQAPP = SAP/QAPP
SVOC = semivolatile organic compound
TAL = target analyte list
TBT = tributyltin
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

References:
Washington State Department of Ecology (Ecology), 1995, Initial Investigation Inspection, Sesko Property, March 29, 1995.
GeoEngineers, 2007a, Preliminary Upland Assessment Work Plan, McConkey/Sesko Site, June 1, 2007.
GeoEngineers, 2007b, Preliminary Upland Assessment Report, McConkey/Sesko Brownfield Site, Prepared by GeoEngineers, Inc., for the City of Bremerton, October 26, 2007.
Ecology & Environment, Inc. (E&E), 2008, Final Bremerton Gasworks Targeted Brownfields Assessment Sampling and Quality Assurance Project Plan, Prepared by E&E for EPA, March 5, 2008.
Ecology & Environment, Inc. (E&E), 2009, Final Bremerton Gasworks Targeted Brownfields Assessment Report, Prepared by E&E for U.S. Environmental Protection Agency, August 2009.
Anchor QEA, 2011, Final Completion Report: Former Bremerton MGP Site, Incident Action and Time Critical Removal Action, Prepared for U.S. Coast Guard Sector Puget Sound Incident Management Division on behalf of Cascade Natural Gas Corporation, January 2011.
US Environmental Protection Agency (EPA), 2010 Site-Specific Sampling Plan, Bremerton MGP Release, October 28, 2010.

Table 3-9 - Summary of Data Quality Review for Existing Sediment and Tissue Data
Bremerton Gas Works Superfund Site
Bremerton, WA

	Study/Media					
	2010 and 2012 ENVVEST	2005, 2007 NOAA Mussel Watch @ station SIWP	2001 303d Ecology Clam Crab	2008-2009 PSAMP - Spatial/Temporal - Central Sound	1989-2013 PSAMP Long term/ temporal	2009 - PSAMP Urban Waters Initiative - Bainbridge Basin
	Mussel tissue. Data from 11 locations in Dyes Inlet and Sinclair Inlet considered for regional information.	Mussel Tissue. Data from 1 location in Sinclair Inlet considered for regional information.	Clam and crab tissue. Data from 3 locations in Dyes Inlet considered for regional information.	Sediment. Data from 11 locations in Dyes Inlet and Sinclair Inlet considered for regional information.	Sediment. Data from 1 location in Sinclair Inlet considered for regional information.	Sediment. Data from 18 locations in Dyes Inlet and Sinclair Inlet considered for regional information.
Work Plan Documentation						
Work Plan (SAP/QAPP)	Detailed SAP/QAPP developed with EPA and Ecology under the cooperative Environmental Investment (ENVVEST) program (Johnston et al. 2009; 2010).	Detailed SAP/QAPP developed under NOAA National Status and Trends Program (NOAA 1993 and 2006).	Ecology (2001) QAPP. Results summarized in the 2002 data report and queried from EIM.	Detailed programmatic QAPP (2009) developed cooperatively with State and Federal agencies. Event-specific addenda (2010, 2011, 2012).	Detailed programmatic QAPP (2009) developed cooperatively with State and Federal agencies. Event-specific addenda (2010, 2011, 2012).	Detailed programmatic QAPP (2009) developed cooperatively with State and Federal agencies. Event-specific addenda (2010, 2011, 2012) .
Collection methods, purpose and representativeness	Hand collection of blue mussels (Mytilus spp.) via boat or from shore. Shucked, whole organism. Methods follow NOAA protocol. Location control details provided.	Hand collection of blue mussels (Mytilus spp.) via boat or from shore. Shucked, whole organism. Methods follow NOAA protocol.	Hand collection of male cancer crab tissue (Cancer gracilis) via crab pots (though Dungeness and Blue crabs targeted but none found); native and Japanese little neck clam tissue via hand digging (Protothaca staminea and Tapes japonica).	0.1 m2 modified stainless steel van Veen, lowered via cable to open upon sediment contact. Targeted fine grained sediment, sample rejected in field if not fine-grained dominant during in-field visual inspection.	0.1 m2 modified stainless steel van Veen, lowered via cable to open upon sediment contact. Targeted fine grained sediment, sample rejected in field if not fine-grained dominant during in-field visual inspection.	0.1 m2 modified stainless steel van Veen, lowered via cable to open upon sediment contact. Targeted fine grained sediment, sample rejected in field if not fine-grained dominant during in-field visual inspection.
Sample Location and Collection Methods						
Location method, accuracy and datum	Location established with GPS; accuracy not specified. Table provided with coordinates. Datum not specified.	Location established with GPS. Accuracy and datum not specified.	Location established with GPS, accuracy not specified. Table provided with coordinates. Datum is NAD 83.	Location established with differential GPS. with expected accuracy of better than 3 meters. Table provided with coordinates. Datum is NAD 83.	Location established with differential GPS. with expected accuracy of better than 3 meters. Table provided with coordinates. Datum is NAD 83.	Location established with differential GPS. with expected accuracy of better than 3 meters. Table provided with coordinates. Datum is NAD 83.
Sample depths	Above MLLW - on rocks, piling, cabling, piers.	Detailed in NOAA (1993) SAP. Depends on station, some shoreline, some underwater.	Crabs: via pots on surface Clams: via hand digging within 100 sq ft of beach.	Top 2-3cm.	Top 2-3cm.	Top 2-3cm.
Sample collection, processing and handling	Field - Hand harvest, cut byssus threads with knife; hand brush off debris; 1-3 replicates per stations (reps within 150' radius of station loc; 30-50 mussels per replicate. Hand delivery to lab. Lab - kept at -20C until measured and shucked with ceramic knife; rinsed with DI, composite by replicate then by station using Ti blender.	Field - Detailed in NOAA (1993) SAP. In general, some stations hand collection or with rake, some with bivalve dredge. Lab - shell size and volume determined; shucked; homogenized using stainless steel blender with titanium blades. Chemically dried using hydromatrix.	Detailed in SAP.Crabs: Muscle tissue (no organs or shell). Clams: Non depurated. Both crabs and clams samples homogenized in stainless steel blender.	Field - stainless steel spoon from each grab; grabs composited into stainless steel bucket; salinity and sediment temp measured.	Field - stainless steel spoon from each grab; grabs composited into stainless steel bucket; salinity and sediment temp measured.	Field - stainless steel spoon from each grab; grabs composited into stainless steel bucket; salinity and sediment temp measured.
Holding time, preservation, and chain of custody	Requirements detailed in the QAPP. Holding times and preservation were met as documented in the data report. Chain of custody provided in the data report.	Procedures detailed in NOAA (1993) SAP. Actual COCs not available.	Requirements detailed in the QAPP. Holding times and preservation were met as documented in the data report. Chain of custody provided in the data report.	Requirements detailed in the QAPP. Holding times and preservation were met as documented in the data report. Chain of custody provided in the data report.	Requirements detailed in the QAPP. Holding times and preservation were met as documented in the data report. Chain of custody provided in the data report.	Requirements detailed in the QAPP. Holding times and preservation were met as documented in the data report. Chain of custody provided in the data report.
Laboratory Analysis						
Analytical methods are standard or EPA approved	Total Hg - EPA 7473m (EPA 1631 rev E in QAPP). Battelle SOPS for other metals and PCB congeners, PAHs - GC/MS Battelle SOP -015. Standard analytical methods. Lipids, moisture, C and N isotopes, trace metals, Hg, isotopes, 20 NS&T PCB congeners, parent and alkylated PAH.	Lipids, moisture, C and N isotopes, trace metals, Hg, isotopes, 20 NS&T PCB congeners, parent and alkylated PAH. Detailed in specific analytical methods reports. Standard analytical methods.	Lipid, andimony, SVOCs, PAHs. USEPA and PSEP standard analytical methods.	Grain size, TOC, metals, pesticides, chlorobenzenes, PAHs, phenolics, phthalates, PCBs, PBDEs, bPA, triclosan, and other misc. including HCBd, dibenzofuran, carbazole and tin. EPA and PSEP standard analytical methods.	USEPA and PSEP standard analytical methods.	USEPA and PSEP standard analytical methods.
Detection limits and qualifiers determined based on EPA guidance	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.	Yes. Detailed in QAPP and summarized in QA/QC narrative in data report.
Measurement instruments and calibration procedures	Detailed in QAPP.	Detailed in QAPP.	Detailed in QAPP.	Detailed in QAPP.	Detailed in QAPP.	Detailed in QAPP.
Quality Control and Data Validation						
Field/Lab quality control samples (duplicates, blanks)	B, BS, MS/MSD, LD, reference material.	B, BS, MS/MSD, LD, reference material.	Blank, MS/MSD.	Blind field split replicates, field blanks; lab replicates, MS/MSD, lab control, MB, reference material.	Blind field split replicates, field blanks; lab replicates, MS/MSD, lab control, MB, reference material.	Blind field split replicates, field blanks; lab replicates, MS/MSD, lab control, MB, reference material.
Analytical chemistry data must have been validated and qualified consistent with EPA functional guidelines	Data validation conducted. Details in case narratives.	Not available online.	Data validation conducted. Details in case narratives.	Data validation conducted. Details in case narratives.	Data validation conducted. Details in case narratives.	Data validation conducted. Details in case narratives.
Laboratory data reports	Level II Data Package Available.	Not available online.	Case narrative text only.	Level II Data Package Available.	Only case narratives available through 2000. Online archives incomplete.	Level II Data Package Available.

Notes:
B = Blank
bPA = Bisphenol A
BS = Blank spike
COCs = chemical of concerns
EPA = U.S. Environmental Protection Agency
HCBd = Hexachlorobutadiene
GPS = global positioning system
LCS = Laboratory control sample
MB = Method blank
MS/MSD = Matrix spike/matrix spike duplicate
MLLW = Mean lower-low water
NOAA = National Oceanic and Atmospheric Administration
PAHs = polycyclic aromatic hydrocarbons
PBDE = Polybrominated diphenyl ether
PCBs = polychlorinated biphenyls
PSEP = Puget Sound Estuary Program
QAPP = Quality Assurance Project Plan
QA/QC = quality assurance/quality control
SAP = Sampling and Analysis Plan
SVOC = semivolatile organic compound
TAL = Target analyte list
TOC = Total organic carbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

References:
1989-2013 PSAMP
2008-2009 PSAMP
2009 PSAMP

2010 and 2012 ENVVEST (Johnston 2010 and Brandenberger 2012)

Johnston et al. 2009; 2010

1993 SAP

2005, 2007 NOAA Mussel Watch

2001 303d Ecology Clam Crab

Striplin, P.L., 1988. Puget Sound Ambient Monitoring Program: Marine Sediment Quality Implementation Plan. Washington State Department of Ecology, Olympia, Washington. 57 pp. www.ecy.wa.gov/biblio/88e37.html. Also see QAPP addendum PSAMP (2009, 2010, 2011, and 2012)
PSAMP. 2009. Quality Assurance Project Plan. The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component. August 2009. Publication No. 09-03-12:
PSAMP. 2010 Addendum to Quality Assurance Project Plan. The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component. August 2010. Publication No. 09-03-121-Addendum:
PSAMP. 2011 Addendum to Quality Assurance Project Plan. The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component. August 2010. Publication No. 09-03-121-Addendum:
PSAMP. 2012 Addendum to Quality Assurance Project Plan. The Puget Sound Assessment and Monitoring Program/Urban Waters Initiative: Sediment Monitoring in the San Juan Islands and Port Gardner/ Everett Harbor. December 2011. Publication No. 09-03-121-Addendum
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NOAA. 2006b. Kimbrough, K. L., G. G. Lauenstein and W. E. Johnston (Editors). 2006. Organic Contaminant Analytical Methods of the National Status and Trends Program: Update 2000-2006. NOAA Technical Memorandum NOS NCCOS 30. 137 pg
NOAA. 2008. Kimbrough, K. L., W. E. Johnston, G. G. Lauenstein, J. D. Christensen and D. A. Apeti.. An Assessment of Two Decades of Contaminant Monitoring in the Nation's Coastal Zone. Silver Spring, MD. NOAA Technical. Memorandum NOS NCCOS 74. 105 pp.
Washington State Department of Ecology (Ecology). 2002. Results of Sampling to Verify 303(d) Listings for Chemical Contaminants in Shellfish from Dyes Inlet and Port Washington Narrows. March 2002. Publication No. 02-03-01

Table 3-10 - Summary of Soil Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Soil PRG (mg/kg)	Detected Concentrations Exceeding the PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the PRG	Puget Sound Background Metals Concentration (mg/kg) ¹	Number of Detected Concentrations Exceeding Puget Sound Background Concentration	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed Puget Sound Background Concentration
Total Petroleum Hydrocarbons (TPH)	Gasoline Range Hydrocarbons	15	59	11	645	5						
	Diesel Range Hydrocarbons	15	58	10	36,000	17.1						
	Oil Range Hydrocarbons	15	58	11	29,000	18						
Metals	Aluminum	7	42	42	24,100	5,780	7,700	34		32,600		
	Antimony	13	31	2	1.2	0.8	0.27	2	29	5		12
	Arsenic	15	59	59	48.4	0.5	0.68	55		7	2	
	Barium	7	42	42	120	23.9	330			255		
	Beryllium	15	59	42	0.5	0.1	16			0.6		7
	Cadmium	15	59	34	1.6	0.2	0.36	21	25	1	4	
	Calcium	7	42	42	21,300	1,620						
	Chromium (Total)	15	59	59	60.8	14.6	26	32		48	11	
	Chromium (VI)	8	17				0.3		17			
	Cobalt	7	42	42	19	3.3	2.3	42		11	15	
	Copper	15	59	59	79.1	8	28	18		36	17	
	Iron	7	42	42	47,800	9,570	5,500	42		36,100	3	
	Lead	15	59	57	246	0.6	11	7		24	6	
	Magnesium	7	42	42	14,900	1,380						
	Manganese	7	42	42	824	170	180	38		1,200		
	Mercury	15	59	14	1.62	0.1	1.1	1		0.07	14	45
	Nickel	15	59	59	66.3	21.2	38	27		48	17	
	Potassium	7	42	42	2,000	233						
	Selenium	15	59				0.52		57	0.78		42
	Silver	15	59				4.2			0.61		46
	Sodium	7	42	42	565	120						
	Thallium	15	59	34	5.7	1.1	0.078	34	25			
	Vanadium	7	42	42	86	20.7	7.8	42		45	17	
	Zinc	15	59	59	376	18.9	46	23		85	5	
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	18	60	19	31.2	0.0012	360					
	Acenaphthylene	23	61	23	460	0.00091						
	Anthracene	20	61	24	274	0.0012	1800					
	Benzo(g,h,i)perylene	19	61	46	79	0.00071						
	Dibenzofuran	15	59	4	0.37	0.017	7.3		3			
	Fluoranthene	22	61	32	572	0.00068	240	1				
	Fluorene	20	61	25	404	0.0007	240	1				
	Phenanthrene	24	61	39	1490	0.00061						
	Pyrene	21	61	38	913	0.0006	180	2				
	1-Methylnaphthalene	12	17	10	615	0.0144	18	5				
	2-Methylnaphthalene	13	17	10	978	0.0158	24	5				
	Naphthalene	10	12	11	953	0.00047	3.8	4				
	Benz(a)anthracene	18	61	29	113	0.0011	0.16	15	2			
Carcinogenic PAHs (cPAHs)	Benzo(a)pyrene	17	61	40	116	0.00053	0.016	21				
	Benzo(b)fluoranthene	17	61	29	57.4	0.00085	0.16	15	1			
	Benzo(k)fluoranthene	17	61	36	60.6	0.00056	1.6	10				
	Chrysene	17	61	35	146	0.00067	16	6				
	Dibenzo(a,h)anthracene	17	61	36	22.8	0.0008	0.016	16	3			
	Indeno(1,2,3-cd)pyrene	17	61	44	58.5	0.00066	0.16	15	1			
	Total cPAHs TEQ (ND = 0)	17	61	50	149	0.000066	0.016	21				
	Total cPAHs TEQ (ND = 1/2 RDL)	17	61	50	149	0.000842	0.016	21				
	Total HPAHs	2	2	2	76.22	21.32	1.1	2				
	Total LPAHs	2	2	2	121.5	3.813	29	1				
	Total PAHs	2	2	2	197.72	25.133						
	1,1'-Biphenyl	7	42	5	0.98	0.014	4.7					
	1,2,4,5-Tetrachlorobenzene	7	42				2.3					
	1,2-Dichlorobenzene	1	1				180					
	1,3-Dichlorobenzene	7	40									
	1,4-Dichlorobenzene	1	1				2.6					
	1,4-Dioxane	7	42				5.3		2			
	2,3,4,6-Tetrachlorophenol	7	42				190					
	2,4,5-Trichlorophenol	15	59				630					
	2,4,6-Trichlorophenol	15	59				6.3		4			
	2,4-Dichlorophenol	15	59				19		2			
	2,4-Dimethylphenol	15	59	1	0.031	0.031	130		1			

Table 3-10 - Summary of Soil Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Soil PRG (mg/kg)	Detected Concentrations Exceeding the PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the PRG	Puget Sound Background Metals Concentration (mg/kg) ¹	Number of Detected Concentrations Exceeding Puget Sound Background Concentration	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed Puget Sound Background Concentration
Other Semi-Volatile Organic Compounds (SVOCs)	2,4-Dinitrophenol	15	59				13		3			
	2-Chloronaphthalene	15	59				480					
	2-Chlorophenol	15	59				39		2			
	2-Methylphenol	8	17				320					
	2-Nitroaniline	15	59				63		2			
	2-Nitrophenol	15	59									
	3 & 4 Methylphenol	8	17									
	3,3'-Dichlorobenzidine	15	59				1.2		17			
	3-Nitroaniline	15	59									
	4,6-Dinitro-2-methylphenol	15	59				0.51		17			
	4-Bromophenyl phenyl ether	15	59									
	4-Chloro-3-methylphenol	15	59				630					
	4-Chloroaniline	15	59				2.7		8			
	4-Chlorophenyl phenyl ether	15	59									
	4-Methylphenol	7	42				630					
	4-Nitroaniline	15	59				25		2			
	4-Nitrophenol	15	59									
	Acenaphthene	1	1				360					
	Acetophenone	7	42	2	1.5	0.03						
	Aniline	8	17				44		2			
	Atrazine	7	42									
	Benzaldehyde	7	42									
	Benzidine	7	42				0.00053		42			
	Benzoic acid	8	17				25,000					
	Benzyl alcohol	8	17				630					
	Benzyl butyl phthalate	15	59	5	0.029	0.015	290					
	Bis(2-chloro-1-methylethyl) ether	15	59				310					
	Bis(2-chloroethoxy)methane	15	59				19		2			
	Bis(2-chloroethyl) ether	15	59				0.23		17			
	Bis(2-ethylhexyl) phthalate	15	59	39	0.29	0.069	39		2			
	Caprolactam	7	42	1	0.015	0.015						
	Carbazole	15	59	5	0.49	0.019						
	Dibenzofuran	2	2	2	2.6	0.082	7.3					
	Diethyl phthalate	15	59				5,100					
	Dimethyl phthalate	15	59									
	Di-n-butyl phthalate	15	59	3	0.016	0.013	630					
	Di-n-octyl phthalate	15	59				63		2			
	Hexachlorobenzene	15	59				0.21		17			
	Hexachlorobutadiene	1	1				1.2					
	Hexachlorocyclopentadiene	15	59				0.18		17			
	Hexachloroethane	15	56				1.8		8			
	Isophorone	15	59	1	6.3	6.3	570					
	Naphthalene	1	1	1	0.00071	0.00071	3.8					
	Nitrobenzene	8	17				5.1		4			
	N-Nitrosodimethylamine	7	42				0.002		42			
	N-Nitroso-di-n-propylamine	15	59				0.078		17			
	N-Nitrosodiphenylamine	15	59				110		1			
	Pentachlorophenol	15	59	3	0.0036	0.00081	1		10			
	Phenol	15	59	6	0.1	0.023	1,900					
	2,4-Dinitrotoluene	8	17				1.7		8			
	2,6-Dinitrotoluene	8	17				0.36		17			
	2-Methylnaphthalene	7	42	17	63	0.0006	24	1				
	1,1,1,2-Tetrachloroethane	15	59				2		2			
	1,1,1-Trichloroethane	15	59				810					
	1,1,2 - Trichlorotrifluoroethane	7	42				4,000					
	1,1,2,2-Tetrachloroethane	15	59				0.6		2			
	1,1,2-Trichloroethane	15	59				0.15		5			
	1,1-Dichloroethane	15	59				3.6		1			
	1,1-Dichloroethene	15	57				23					
	1,1-Dichloropropene	8	17									
	1,2,3-Trichlorobenzene	15	59	6	0.00017	0.00013	6.3		2			
	1,2,3-Trichloropropane	15	59				0.0051		11			

Table 3-10 - Summary of Soil Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Soil PRG (mg/kg)	Detected Concentrations Exceeding the PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the PRG	Puget Sound Background Metals Concentration (mg/kg) ¹	Number of Detected Concentrations Exceeding Puget Sound Background Concentration	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed Puget Sound Background Concentration
Volatile Organic Compounds (VOCs)	1,2,4-Trichlorobenzene	15	59	2	0.00023	0.00014	5.8		2			
	1,2,4-Trimethylbenzene	15	59	9	13.2	0.014	5.8	4				
	1,2-Dibromo-3-chloropropane	15	59				0.0053		19			
	1,2-Dibromoethane (EDB)	15	59				0.036		11			
	1,2-Dichlorobenzene	15	58				180					
	1,2-Dichloroethane (EDC)	15	59				0.46		4			
	1,2-Dichloropropane	15	58				1		2			
	1,3,5-Trimethylbenzene	15	59	8	5.5	0.026	78					
	1,3-Dichlorobenzene	9	19									
	1,3-Dichloropropane	8	17				160					
	1,4-Dichlorobenzene	15	58	1	0.00037	0.00037	2.6		1			
	1,4-Difluorobenzene	1	1	1	2	2						
	2,2-Dichloropropane	8	17									
	2-Butanone	15	59	2	2.4	0.015	2,700					
	2-Chlorotoluene	8	17				160					
	2-Hexanone	15	59				20		1			
	4-Chlorotoluene	8	17				160					
	4-Methyl-2-pentanone	15	59				3,300					
	Acetone	15	59	30	0.064	0.0065	6,100					
	Benzene	15	59	22	12	0.00069	1.2	3				
	Bromobenzene	8	17				29					
	Bromochloromethane	15	59				15					
	Bromodichloromethane	15	59				0.29		5			
	Bromoform	15	59				19					
	Bromomethane	15	58				0.68		2			
	Carbon disulfide	15	59	4	0.0075	0.0043	77					
	Carbon tetrachloride	15	59				0.65		2			
	Chlorobenzene	15	59				28					
	Chlorobenzene-d5	1	1	1	2	2						
	Chloroethane	15	59				1,400					
	Chloroform	15	59	3	0.044	0.00048	0.32		5			
	Chloromethane	15	59				11		1			
	cis-1,2-Dichloroethene (DCE)	15	59				16					
	cis-1,3-Dichloropropene	15	59	3	0.93	0.00063						
	Cyclohexane	7	42				650					
	Dibromochloromethane	15	59				8.3					
	Dibromomethane	8	17				2.4		1			
	Dichlorodifluoromethane	15	59				8.7					
	Ethylbenzene	15	59	16	24	0.00073	5.8	1				
	Hexachlorobutadiene	15	58				1.2		3			
	Hexachloroethane	1	3				1.8					
	Isopropylbenzene	15	59	7	1.6	0.00094	190					
	Methyl acetate	7	42	1	0.16	0.16	7,800					
	Methyl tert-butyl ether (MTBE)	15	59				47					
	Methylcyclohexane	7	42	3	0.0038	0.00037						
	Methylene chloride	15	59	24	1.3	0.00058	35		1			
	n-Butylbenzene	8	17	2	1.96	1.78	390					
	n-Hexane	8	17	1	0.00121	0.00121	61					
	n-Propylbenzene	8	17	2	0.952	0.792	380					
	Pentafluorobenzene	2	3	3	2	0.04						
	p-Isopropyltoluene	8	17	4	1.65	0.493						
	sec-Butylbenzene	8	17	2	0.915	0.748	780					
	Styrene	15	59	4	0.07	0.000814	600					
	tert-Butylbenzene	8	17				780					
	Tetrachloroethene (PCE)	15	59	3	0.00059	0.00044	8.1					
	Toluene	15	59	30	7.5	0.00026	490					
	trans-1,2-Dichloroethene	15	59				160					
	trans-1,3-Dichloropropene	15	59	3	0.93	0.00063						
	Trichloroethene (TCE)	15	59	3	0.00147	0.00044	0.41		5			
	Trichlorofluoromethane	15	59	13	0.0078	0.0006	2300					
	Vinyl chloride	15	59				0.059		11			
	m,p-Xylenes	13	50	9	57	0.00052						

Table 3-10 - Summary of Soil Data
Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Soil PRG (mg/kg)	Detected Concentrations Exceeding the PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the PRG	Puget Sound Background Metals Concentration (mg/kg) ¹	Number of Detected Concentrations Exceeding Puget Sound Background Concentration	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed Puget Sound Background Concentration
	o-Xylene	13	50	8	55	0.00049	65					
	Xylenes (total)	8	17	7	16.7	0.353	58					
	Naphthalene	14	49	33	708	0.00059	3.8	7				
Polychlorinated Biphenyls (PCBs)	Aroclor 1016	8	17				0.41					
	Aroclor 1221	8	17				0.2					
	Aroclor 1232	8	17				0.17					
	Aroclor 1242	8	17				0.23					
	Aroclor 1248	8	17				0.23					
	Aroclor 1254	8	17				0.12					
	Aroclor 1260	8	17				0.24					
	Aroclor 1262	8	17									
	Aroclor 1268	8	17									

Reference: U.S. Environmental Protection Agency (EPA), 1993, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, Office of Research and Development, Office of Health and Environmental Assessment, Washington, DC, EPA/600/R-93/089.

Table 3-11 - Summary of Groundwater Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/L)	Minimum Detected Concentration (ug/L)	Groundwater PRG (ug/L)	Number of Detected Concentrations Exceeding the Groundwater PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Groundwater PRG	Surface Water PRG (ug/L)	Number of Detected Concentrations Exceeding the Surface Water PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Surface Water PRG
Total Petroleum Hydrocarbons (TPH)	Gasoline-Range Hydrocarbons	10	10	7	10,600	63.5						
	Diesel-Range Hydrocarbons	11	11	6	18,500	170						
	Oil-Range Hydrocarbons	11	11	1	160	160						
Metals	Antimony	10	10	2	0.4	0.3	0.78		8	90		
	Arsenic	10	10	10	26	0.6	0.052	10		0.14	10	
	Barium	2	2	2	173	35.7	380					
	Beryllium	10	10	3	1.08	0.37	2.5			0.66	2	7
	Cadmium	10	10	2	0.16	0.05	0.92		8	8.8		
	Chromium (Total)	10	10	10	228	1.34	100	2		42	3	
	Chromium (VI)	8	8	7	90	6	0.035	7	1	50	2	
	Cobalt	2	2	2	8.3	1.4	0.6	2				
	Copper	10	10	10	143	1.05	80	2		3.1	8	
	Lead	10	10	8	21.6	0.44	15	2		8.1	2	
	Manganese	2	2	2	3,020	98.1	43	2				
	Mercury	8	8	1	0.246	0.246	0.063	1	7	0.94		
	Nickel	10	10	10	232	1.65	39	3		8.2	7	
	Selenium	10	10	1	3.64	3.64	10			71		
	Silver	10	10	1	0.07	0.07	9.4			1.9		
	Thallium	10	10	1	0.26	0.26	0.02	1	9	6.3		
	Vanadium	2	2	2	78.2	3.7	8.6	1				
	Zinc	10	10	8	185	4.5	600			81	2	
TCLP Metals	Mercury	8	8	1	0.246	0.246	0.063	1	7	0.94		
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	9	9	5	485	1.1	53	1		30	1	
	Acenaphthylene	10	10	6	34.9	0.222				4,840		
	Anthracene	10	10	5	120	0.4	180			100	1	
	Benzo(g,h,i)perylene	10	10	5	25.6	0.0979				7.64	1	
	Dibenzofuran	10	10	2	31.8	0.29	0.79	1	7	4	1	7
	Fluoranthene	10	10	6	122	0.26	80	1		6	2	
	Fluorene	10	10	7	184	0.102	29	1		10	2	
	Phenanthrene	10	10	5	377	1.04				1.5	3	
	Pyrene	10	10	7	34.5	0.174	12	2		8	2	
	1-Methylnaphthalene	8	8	4	970	0.813	1.1	3	1	2.1	3	1
	2-Methylnaphthalene	10	10	6	1,430	0.13	3.6	1		4.2	1	
	Naphthalene	2	2				0.17			1.4		
Carcinogenic PAHs (cPAHs)	Benz(a)anthracene	10	10	6	39.3	0.0168	0.012	6	2	0.00016	6	4
	Benzo(a)pyrene	10	10	6	37.6	0.0247	0.0034	6	4	0.000016	6	4
	Benzo(b)fluoranthene	10	10	4	0.657	0.0968	0.034	4	3	0.00016	4	6
	Benzo(k)fluoranthene	10	10	5	0.615	0.0602	0.34	2	1	0.0016	5	5
	Chrysene	10	10	6	40.8	0.0372	3.4	1		0.016	6	2
	Dibenzo(a,h)anthracene	10	10	4	0.189	0.0437	0.0034	4	6	0.000016	4	6
	Indeno(1,2,3-cd)pyrene	10	10	4	0.467	0.0874	0.034	4	3	0.00016	4	6
	Total cPAHs TEQ (ND = 0)	10	10	6	41.9	0.0328	0.0034	6		0.000016	6	
	Total cPAHs TEQ (ND = 1/2 RDL)	10	10	6	43.8	0.0342	0.0034	6		0.000016	6	

Table 3-11 - Summary of Groundwater Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/L)	Minimum Detected Concentration (ug/L)	Groundwater PRG (ug/L)	Number of Detected Concentrations Exceeding the Groundwater PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Groundwater PRG	Surface Water PRG (ug/L)	Number of Detected Concentrations Exceeding the Surface Water PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Surface Water PRG
Other Semivolatile Organic Compounds (SVOCs)	1,1'-Biphenyl	2	2				0.083		2	14		
	1,2,4,5-Tetrachlorobenzene	2	2				0.17		2	1.1		
	1,2,4-Trimethylbenzene	1	1				1.5			19		
	2,3,4,6-Tetrachlorophenol	2	2				24			1.2		
	2,4,5-Trichlorophenol	10	10				120			12		
	2,4,6-Trichlorophenol	10	10				1.2		8	0.28		10
	2,4-Dichlorophenol	10	10				4.6		8	10		1
	2,4-Dimethylphenol	10	10				36			97		
	2,4-Dinitrophenol	10	10				3.9		8	100		
	2-Chloronaphthalene	10	10				75			100		
	2-Chlorophenol	10	10				9.1		8	17		
	2-Methylphenol	8	8				93			67		
	2-Nitroaniline	10	10				19					
	2-Nitrophenol	10	10							2,940		
	3 & 4 Methylphenol	8	8									
	3,3'-Dichlorobenzidine	10	10				0.13		10	0.0033		10
	3-Nitroaniline	10	10									
	4,6-Dinitro-2-methylphenol	10	10				0.15		10	7		8
	4-Bromophenyl phenyl ether	10	10							1.5		8
	4-Chloro-3-methylphenol	10	10				140			36		
	4-Chloroaniline	10	10				0.37		10	232		
	4-Chlorophenyl phenyl ether	10	10									
	4-Methylphenol	2	2				190			25		
	4-Nitroaniline	10	10				3.8		8			
	4-Nitrophenol	10	10							60		
	Acenaphthene	1	1	1	4.9	4.9	53			30	1	
	Acetophenone	2	2				190					
	Aniline	8	8				13			2.2		8
	Atrazine	2	2				0.3		2	1.8		
	Benzaldehyde	2	2				19					
	Benzidine	2	2				0.00011		2	0.000023		2
	Benzoic acid	8	8				7,500			42		
	Benzyl alcohol	8	8				200			8.6		8
	Benzyl butyl phthalate	10	10	1	0.33	0.33	16			0	1	9
	Bis(2-chloro-1-methylethyl) ether	10	10				71			900		
	Bis(2-chloroethoxy)methane	10	10				5.9		8			
	Bis(2-chloroethyl) ether	10	10				0.014		10	0.06		10
	Bis(2-ethylhexyl) phthalate	10	10	2	0.5	0.33	5.6		8	0.046	2	8
	Caprolactam	2	2	1	0.71	0.71	990					
	Carbazole	10	10	1	1.3	1.3						
	Diethyl phthalate	10	10				1,500			200		
	Dimethyl phthalate	10	10							600		
	Di-n-butyl phthalate	10	10				90			8		8
	Di-n-octyl phthalate	10	10				20			22		
	Hexachlorobenzene	10	10				0.0098		10	0.000005		10
	Hexachlorocyclopentadiene	10	10				0.041		10	1		8
	Hexachloroethane	10	10				0.33		10	0.02		10
	Isophorone	10	10				78			110		
	Nitrobenzene	8	8				0.14		8	100		
	N-Nitrosodimethylamine	2	2				0.00011		2	0		2
	N-Nitroso-di-n-propylamine	10	10				0.011		10	0.058		10

Table 3-11 - Summary of Groundwater Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/L)	Minimum Detected Concentration (ug/L)	Groundwater PRG (ug/L)	Number of Detected Concentrations Exceeding the Groundwater PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Groundwater PRG	Surface Water PRG (ug/L)	Number of Detected Concentrations Exceeding the Surface Water PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Surface Water PRG
	N-Nitrosodiphenylamine	10	10				12			0.69		8
	Pentachlorophenol	10	10	2	11.4	0.1	0.041	2	8	0.002	2	8
	Phenol	10	10	3	81.6	75.5	580			70,000		
	2,4-Dinitrotoluene	8	8				0.24		8	0.18		8
	2,6-Dinitrotoluene	8	8				0.049		8	81		
Volatile Organic Compounds (VOCs)	1,1,1,2-Tetrachloroethane	10	10				0.57					
	1,1,1-Trichloroethane	10	10				200			50000		
	1,1,2 - Trichlorotrifluoroethane	2	2				5,500					
	1,1,2,2-Tetrachloroethane	10	10				0.076		10	0.3		8
	1,1,2-Trichloroethane	10	10				0.041		10	0.9		
	1,1-Dichloroethane	10	10				2.8			47		
	1,1-Dichloroethene	9	9				7			4,000		
	1,1-Dichloropropene	8	8									
	1,2,3-Trichlorobenzene	10	10				0.7		8	8		
	1,2,3-Trichloropropane	10	10				0.00075		10			
	1,2,4-Trichlorobenzene	10	10				0.4		10	0.037		10
	1,2,4-Trimethylbenzene	9	9	5	179	3.52	1.5	5		19		
	1,2-Dibromo-3-chloropropane	10	10				0.00033		10			
	1,2-Dibromoethane (EDB)	10	10				0.0075		10			
	1,2-Dichlorobenzene	10	10				30			800		
	1,2-Dichloroethane (EDC)	10	10	3	4.72	0.93	0.17	3	7	73		
	1,2-Dichloropropane	10	10				0.44			3.1		
	1,3,5-Trimethylbenzene	10	10	5	30	0.53	12	1		71		
	1,3-Dichlorobenzene	10	10							2		
	1,3-Dichloropropane	8	8				37					
	1,4-Dichlorobenzene	10	10				0.48			200		
	2,2-Dichloropropane	8	8									
	2-Butanone	10	10				560			2,200		
	2-Chlorotoluene	8	8				24					
	2-Hexanone	10	10				3.8		2	99		
	4-Chlorotoluene	8	8				25					
	4-Methyl-2-pentanone	10	10				630			170		
	Acetone	10	10				1,400			1,700		
	Benzene	10	10	8	950	2.23	0.46	8		1.6	8	
	Bromobenzene	8	8				6.2					
	Bromochloromethane	10	10				8.3					
	Bromodichloromethane	10	10				0.13		10	2.8		
	Bromoform	10	10				3.3			12		
	Bromomethane	10	10				0.75		8	2,400		
	Carbon disulfide	10	10				81			0.92		
	Carbon tetrachloride	10	10	1	0.66	0.66	0.46	1		0.35	1	
	Chlorobenzene	10	10				7.8			200		
	Chloroethane	10	10				2,100					
	Chloroform	10	10	3	2.84	0.2	0.22	2	2	600		
	Chloromethane	10	10				19			2,700		
	cis-1,2-Dichloroethene (DCE)	10	10	3	1.29	0.37	3.6					
	cis-1,3-Dichloropropene	10	10							1.2		
	Cyclohexane	2	2	1	0.38	0.38	1,300					
	Dibromochloromethane	10	10				0.87			2.2		
	Dibromomethane	8	8				0.83					
	Dichlorodifluoromethane	10	10				20					

Table 3-11 - Summary of Groundwater Data
Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/L)	Minimum Detected Concentration (ug/L)	Groundwater PRG (ug/L)	Number of Detected Concentrations Exceeding the Groundwater PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Groundwater PRG	Surface Water PRG (ug/L)	Number of Detected Concentrations Exceeding the Surface Water PRG	Number of Non-Detect Results with Reporting Limit Concentrations that Exceed the Surface Water PRG
	Ethylbenzene	10	10	7	322	0.53	1.5	6		31	4	
	Hexachlorobutadiene	10	10				0.14		10	0.01		10
	Isopropylbenzene	10	10	6	37.4	3	45			2.6	6	
	Methyl acetate	2	2				2,000					
	Methyl tert-butyl ether (MTBE)	10	10				14			11,070		
	Methylcyclohexane	2	2									
	Methylene chloride	10	10				5			100		
	n-Butylbenzene	8	8	4	5.3	0.48	100					
	n-Hexane	8	8	1	1.17	1.17	150			0.58	1	7
	n-Propylbenzene	8	8	4	9.2	2.38	66			128		
	p-Isopropyltoluene	8	8	4	8.44	0.27				85		
	sec-Butylbenzene	8	8	5	4.43	0.32	200					
	Styrene	10	10				100			32		
	tert-Butylbenzene	8	8				69					
	Tetrachloroethene (PCE)	10	10				4.1			2.9		
	Toluene	10	10	6	41.9	0.45	110			130		
	trans-1,2-Dichloroethene	10	10				36			1,000		
	trans-1,3-Dichloropropene	10	10							1.2		
	Trichloroethene (TCE)	10	10	6	4.79	0.33	0.28	6		0.7	1	
	Trichlorofluoromethane	10	10				520					
	Vinyl chloride	10	10				0.019		10	0.18		10
	m,p-Xylenes	10	10	6	383	0.74						
	o-Xylene	10	10	6	211	4.91	19	2				
	Xylenes (total)	8	8	5	593	8.29	19	4		19	4	
	Naphthalene	8	8	8	5,270	0.47	0.17	8		1.4		
Polychlorinated Biphenyls (PCBs)	Aroclor 1016	8	8				0.14					
	Aroclor 1221	8	8				0.0047		8			
	Aroclor 1232	8	8				0.0047		8			
	Aroclor 1242	8	8				0.0078		8			
	Aroclor 1248	8	8				0.0078		8			
	Aroclor 1254	8	8				0.0078		8			
	Aroclor 1260	8	8				0.0078		8			
	Aroclor 1262	8	8									
	Aroclor 1268	8	8									

Reference: U.S. Environmental Protection Agency (EPA), 1993, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, Office of Research and Development, Office of Health and Environmental Assessment, Washington, DC, EPA/600/R-93/089.

Table 3-12 - Summary of Sediment DataBremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/kg)	Minimum Detected Concentration (ug/kg)	Sediment PRG (ug/kg)	Puget Sound Background Sediment Concentration ¹ (ug/kg)	Number of Detected Concentrations Exceeding the PRG	Number of Detected Concentrations Exceeding Puget Sound Background Metals Concentration
TPH	Gasoline Range Hydrocarbons	5	5	0	NA	NA				
	Diesel Range Hydrocarbons	5	5	4	240000	63000				
	Oil Range Hydrocarbons	5	5	5	620000	21000				
Metals	Aluminum	5	5	5	9030000	6020000				
	Antimony	1	1	1	3900	3900	2000	5000	1	
	Arsenic	5	5	5	5100	1500	57000	11000		
	Barium	5	5	5	47000	13300				
	Beryllium	5	5	5	2700	1900				
	Cadmium	5	5	0	NA	NA	5100	800		
	Calcium	5	5	5	33600000	2390000				
	Chromium (Total)	5	5	5	21200	16600	260000	62000		
	Cobalt	5	5	5	26300	3000	50000	11000		
	Copper	5	5	5	71700	8600	390000	45000		
	Iron	5	5	5	15900000	9730000	20000000			
	Lead	5	5	5	30000	8900	450000	21000		
	Magnesium	5	5	5	4640000	3350000				
	Manganese	5	5	5	180000	135000	460000			
	Mercury	3	3	3	100	27.8	410	200		
	Nickel	5	5	5	52600	21400	20900	50000	5	1
	Potassium	5	5	5	603000	415000				
	Selenium	5	5	1	400	400	2000	780		
	Silver	5	5	0	NA	NA	6100	240		
	Sodium	5	5	5	1930000	605000				
	Thallium	5	5	0	NA	NA				
	Vanadium	5	5	5	36500	21600		45000		
	Zinc	5	5	5	79900	23200	410000	93000		
PAHs	Acenaphthene	48	63	61	160000	0.4	500		16	
	Acenaphthylene	51	66	66	840000	0.7	1300		33	
	Anthracene	51	66	66	680000	0.3	960		41	
	Benzo(g,h,i)perylene	51	66	66	260000	0.9	670		50	
	Dibenzofuran	5	5	4	74	58	540			
	Fluoranthene	46	61	61	1100000	1.6	1700		45	
	Fluorene	51	66	65	600000	0.3	540		36	
	Phenanthrene	51	66	66	1700000	2.6	1500		46	
	Pyrene	51	66	66	1400000	1.6	2600		48	
	2-Methylnaphthalene	5	5	5	1200	19	670		1	
	Naphthalene	46	61	61	1700000	5.4	2100		23	
	Benz(a)anthracene	51	66	66	310000	0.3	1300		46	
	Benzo(a)pyrene	51	66	66	400000	0.5	1600		47	
	Benzo(b)fluoranthene	51	66	66	200000	0.4	10400		17	
	Benzo(k)fluoranthene	51	66	65	93000	0.5	240		50	
	Chrysene	51	66	66	270000	0.5	1400		47	
	Dibenzo(a,h)anthracene	51	66	65	38000	0.2	230		46	
	Indeno(1,2,3-cd)pyrene	51	66	66	190000	0.4	600		49	
	Total cPAHs TEQ (ND = 0)	51	66	66	509200	0.6	1600	21	49	
	Total cPAHs TEQ (ND = 1/2 RDL)	51	66	66	509200	0.9	1600	21	49	
	Total HPAHs	46	61	61	4361000	6.2	12000		45	
	Total LPAHs	46	61	61	5596000	10.1	5200		39	
	Total PAHs	46	61	61	8890000	16.3	4022		48	

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Table 3-12 - Summary of Sediment DataBremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/kg)	Minimum Detected Concentration (ug/kg)	Sediment PRG (ug/kg)	Puget Sound Background Sediment Concentration ¹ (ug/kg)	Number of Detected Concentrations Exceeding the PRG	Number of Detected Concentrations Exceeding Puget Sound Background Metals Concentration
Other SVOCs	1,1'-Biphenyl	5	5	4	110	60	1220			
	1,2,4,5-Tetrachlorobenzene	5	5	0	NA	NA	47000			
	1,2,4-Trichlorobenzene	8	9	0	NA	NA	31			
	1,2-Dichlorobenzene	8	9	0	NA	NA	35			
	1,3,5-Trimethylbenzene	1	1	1	21	21				
	1,3-Dichlorobenzene	5	5	0	NA	NA	842			
	1,4-Dichlorobenzene	2	2	2	23	22	110			
	1,4-Dioxane	5	5	0	NA	NA	119			
	2,3,4,6-Tetrachlorophenol	5	5	0	NA	NA	284			
	2,4,5-Trichlorophenol	5	5	0	NA	NA	819			
	2,4,6-Trichlorophenol	5	5	0	NA	NA	2650			
	2,4-Dichlorophenol	5	5	0	NA	NA	117			
	2,4-Dimethylphenol	5	5	0	NA	NA	29			
	2,4-Dinitrophenol	5	5	0	NA	NA	6.21			
	2-Chloronaphthalene	5	5	0	NA	NA	417			
	2-Chlorophenol	5	5	0	NA	NA	344			
	2-Nitroaniline	5	5	0	NA	NA				
	2-Nitrophenol	5	5	0	NA	NA				
	3,3'-Dichlorobenzidine	5	5	0	NA	NA	2060			
	3-Nitroaniline	5	5	0	NA	NA				
	4,6-Dinitro-2-methylphenol	5	5	0	NA	NA	104			
	4-Bromophenyl phenyl ether	5	5	0	NA	NA	1230			
	4-Chloro-3-methylphenol	5	5	0	NA	NA	388			
	4-Chloroaniline	5	5	0	NA	NA	146			
	4-Chlorophenyl phenyl ether	5	5	0	NA	NA				
	4-Methylphenol	5	5	2	17	17	670			
	4-Nitroaniline	5	5	0	NA	NA				
	4-Nitrophenol	5	5	0	NA	NA	13.3			
	Acenaphthene	48	63	61	160000	0.4	500		16	
	Acetophenone	5	5	0	NA	NA				
	Atrazine	5	5	0	NA	NA	6.62			
	Benzaldehyde	5	5	2	38	19				
	Benzidine	5	5	0	NA	NA				
	Benzyl butyl phthalate	5	5	0	NA	NA	63			
	Bis(2-chloro-1-methylethyl) ether	5	5	0	NA	NA				
	Bis(2-chloroethoxy)methane	5	5	0	NA	NA				
	Bis(2-chloroethyl) ether	5	5	0	NA	NA	3520			
	Bis(2-ethylhexyl) phthalate	5	5	1	42	42	1300			
	Caprolactam	5	5	0	NA	NA				
	Carbazole	5	5	4	110	69				
	Dibenzofuran	5	5	4	74	58	540			
	Diethyl phthalate	5	5	0	NA	NA	200			
	Dimethyl phthalate	5	5	0	NA	NA	71			
	Di-n-butyl phthalate	5	5	0	NA	NA	1400			
	Di-n-octyl phthalate	5	5	0	NA	NA	6200			
	Hexachlorobenzene	5	5	0	NA	NA	22			
	Hexachlorobutadiene	8	9	0	NA	NA	11			
	Hexachlorocyclopentadiene	5	5	0	NA	NA	139			
	Hexachloroethane	3	3	0	NA	NA	804			
	Isophorone	5	5	0	NA	NA	432			
	Naphthalene	46	61	61	1700000	5.4	2100		23	

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Table 3-12 - Summary of Sediment DataBremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/kg)	Minimum Detected Concentration (ug/kg)	Sediment PRG (ug/kg)	Puget Sound Background Sediment Concentration ¹ (ug/kg)	Number of Detected Concentrations Exceeding the PRG	Number of Detected Concentrations Exceeding Puget Sound Background Metals Concentration
Other SVOCs (continued)	N-Nitrosodimethylamine	5	5	0	NA	NA				
	N-Nitroso-di-n-propylamine	5	5	0	NA	NA				
	N-Nitrosodiphenylamine	5	5	0	NA	NA	28			
	Pentachlorophenol	5	5	5	110	35	360			
	Phenol	5	5	0	NA	NA	420			
VOCs	2-Methylnaphthalene	5	5	5	1200	19	670		1	
	1,1,1,2-Tetrachloroethane	8	9	0	NA	NA				
	1,1,1-Trichloroethane	8	9	0	NA	NA	856			
	1,1,2 - Trichlorotrifluoroethane	8	9	0	NA	NA				
	1,1,2,2-Tetrachloroethane	8	9	0	NA	NA	202			
	1,1,2-Trichloroethane	8	9	0	NA	NA	570			
	1,1-Dichloroethane	8	9	0	NA	NA	0.575			
	1,1-Dichloroethene	8	9	0	NA	NA	2780			
	1,1-Dichloropropene	3	4	0	NA	NA				
	1,2,3-Trichlorobenzene	8	9	0	NA	NA	858			
	1,2,3-Trichloropropane	8	9	0	NA	NA				
	1,2,4-Trichlorobenzene	8	9	0	NA	NA	31			
	1,2,4-Trimethylbenzene	8	9	4	980	2.4				
	1,2-Dibromo-3-chloropropane	8	9	0	NA	NA				
	1,2-Dibromoethane (EDB)	8	9	0	NA	NA				
	1,2-Dichlorobenzene	8	9	0	NA	NA	35			
	1,2-Dichloroethane (EDC)	8	9	0	NA	NA	260			
	1,2-Dichloropropane	8	9	0	NA	NA	333			
	1,3,5-Trimethylbenzene	1	1	1	21	21				
	1,3-Dichlorobenzene	5	5	0	NA	NA	842			
	1,3-Dichloropropane	3	4	0	NA	NA				
	1,4-Dichloro-2-Butene	3	4	0	NA	NA				
	1,4-Dichlorobenzene	2	2	2	23	22	110			
	2,2-Dichloropropane	3	4	0	NA	NA				
	2-Butanone	8	9	0	NA	NA	42.4			
	2-Chloroethyl Vinyl Ether	3	4	0	NA	NA				
	2-Chlorotoluene	3	4	0	NA	NA				
	2-Hexanone	8	9	0	NA	NA	58.2			
	4-Chlorotoluene	3	4	0	NA	NA				
	4-Methyl-2-pentanone	8	9	0	NA	NA	25.1			
	Acrolein	3	4	0	NA	NA	0.00152			
	Acrylonitrile	3	4	0	NA	NA	1.2			
	Benzene	8	9	3	8.1	1.5	137			
	Bromobenzene	3	4	0	NA	NA				
	Bromochloromethane	8	9	0	NA	NA				
	Bromodichloromethane	8	9	0	NA	NA				
	Bromoethane	3	4	0	NA	NA				
	Bromoform	8	9	0	NA	NA	1310			
	Bromomethane	8	9	0	NA	NA	1.37			
	Carbon disulfide	8	9	1	4.3	4.3	0.851		1*	
	Carbon tetrachloride	8	9	0	NA	NA	7240			
	Chlorobenzene	8	9	0	NA	NA	162			
	Chloroethane	8	9	0	NA	NA				
	Chloroform	8	9	0	NA	NA	121			
	Chloromethane	8	9	0	NA	NA				
	cis-1,2-Dichloroethene (DCE)	8	9	0	NA	NA				

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Table 3-12 - Summary of Sediment Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Group	Chemical Constituent	Number of Locations	Number of Samples	Number of Detections	Maximum Detected Concentration (ug/kg)	Minimum Detected Concentration (ug/kg)	Sediment PRG (ug/kg)	Puget Sound Background Sediment Concentration ¹ (ug/kg)	Number of Detected Concentrations Exceeding the PRG	Number of Detected Concentrations Exceeding Puget Sound Background Metals Concentration
VOCs (continued)	cis-1,3-Dichloropropene	8	9	0	NA	NA				
	Cyclohexane	5	5	0	NA	NA				
	Dibromochloromethane	8	9	0	NA	NA				
	Dibromomethane	3	4	0	NA	NA				
	Dichlorodifluoromethane	5	5	0	NA	NA				
	Ethylbenzene	8	9	2	24	2.3	305			
	Hexachlorobutadiene	8	9	0	NA	NA	11			
	Hexachloroethane	3	3	0	NA	NA	804			
	Isopropylbenzene	8	9	2	9	0.48	86			
	Methyl acetate	5	5	0	NA	NA				
	Methyl tert-butyl ether (MTBE)	5	5	0	NA	NA				
	Methylcyclohexane	5	5	1	0.65	0.65				
	Methylene chloride	8	9	1	1.8	1.8	159			
	Methyliodide	3	4	0	NA	NA				
	n-Butylbenzene	3	4	1	84	84				
	n-Propylbenzene	3	4	1	8.3	8.3				
	p-Isopropyltoluene	3	4	0	NA	NA				
	sec-Butylbenzene	3	4	0	NA	NA				
	Styrene	8	9	0	NA	NA	7070			
	tert-Butylbenzene	3	4	0	NA	NA				
	Tetrachloroethene (PCE)	8	9	0	NA	NA	190			
	Toluene	8	9	2	1.5	0.51	1090			
	trans-1,2-Dichloroethene	8	9	0	NA	NA	1050			
	trans-1,3-Dichloropropene	8	9	0	NA	NA				
	Trichloroethene (TCE)	8	9	0	NA	NA	8950			
	Trichlorofluoromethane	8	9	0	NA	NA				
	Vinyl acetate	3	4	0	NA	NA	13			
	Vinyl chloride	8	9	0	NA	NA	202			
	m,p-Xylenes	8	9	2	2.9	1.7				
	o-Xylene	8	9	2	5.7	3.9				
	Naphthalene	46	61	61	1700000	5.4	2100		23	

Notes:

*Carbon disulfide is a common laboratory chemical. Based on the review of existing analytical data quality, these detections are considered to be the result of laboratory cross-contamination. The results are not considered representative of site conditions.

¹ Background concentrations based on Puget Sound (when available) or Washington State background (Ecology 1994) and the Sediment Cleanup Users Manual II Table 10-1 (Ecology 2015).

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

HPAH = high molecular weight PAH

LPAH = low molecular weight PAH

NA = Not applicable, as there are no detections.

PAHs = polycyclic aromatic hydrocarbons

PCBs = polychlorinated biphenyls

PRG = Preliminary Remediation Goal

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

VOCs = volatile organic compounds

ug/kg = micrograms per kilogram

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Table 4-1 - Summary of Common Ecological Receptors Potentially Present in Vicinity of the Site

Bremerton Gas Works Superfund Site
Bremerton, Washington

Common Regional Species	Potentially Use of Site (Yes/Unlikely)	Notes	Reference
Aquatic Invertebrates			
Benthic Invertebrates			
Amphipods	Yes		KiTSA 2012
Barnacles	Yes		GeoEngineers 2011; KiTSA 2012
Benthic Infaunal Community	Yes		WAC 173-204
Brittle stars	Yes		GeoEngineers 2011
Clams (multiple species)	Yes		Anchor QEA 2012; KiTSA 2012
Mussels (blue and bay)	Yes		GeoEngineers 2011; KiTSA 2012
Oysters	Yes		KiTSA 2012
Polycheate worms	Yes		GeoEngineers 2011; KiTSA 2012
Scallops	Yes		KiTSA 2012
Sand dollar larvae	Yes		
Sea cucumber	Yes		
Benthivorous Shellfish			
Octopus	Yes		KiTSA 2012
Crabs	Yes		
Marine-Dependent Birds			
Piscivorous Raptor			
Bald eagle	Yes	Monitored species (state). Nest in Sinclair Inlet.	KiTSA 2012
Osprey	Yes		
Shore Birds			
Belted kingfisher	Yes		Buchanan 2006
Ducks	Yes		
Glaucous-winged gull	Yes		KiTSA 2012
Great blue heron	Yes	Monitored species (state). There is a heron rookery along southern Sinclair Inlet (KiTSA 2012).	KiTSA 2012
Marbled murrelet	Unlikely	Threatened (NMFS). Listed marbled murrelet are unlikely to be frequently present in Dyes Inlet (Anchor QEA 2012).	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012
Sandpiper	Yes		Buchanan 2006
Other marine and shore birds (American coot, black oystercatcher, brant, bufflehead, canvasback, common murre, cormorants, dowitcher, dunlin, gadwall, geese, green-winged teal, goldeneye, grebe, green heron, pigeon guillemot, gull, loon, merganser, northern pintail, parasitic jaeger, plover, red-necked phalarope, rhinoceros auklet, sanderling, sand piper, scaup, scoter, surfbird, tern, turnstone, and American wigeon)	Yes		NOAA 2000; Buchanan 2006
Fish			
Benthivorous Fish			
Eelpout	Yes		NOAA 2000
Flatfish (English sole, butter sole, dover sole, sand sole, rock sole, CO sole, and starry flounder)	Yes		KiTSA 2012
Other bottomfish (skate, sablefish, greenlings, wolf-eel, Pacific sanddab, and plainfin midshipman)	Yes		NOAA 2000
Perch (pile and striped)	Yes		
Plainfin midshipman	Yes		
Poacher	Yes		
Prickleback	Yes		
Rock sole	Yes		
Spotted ratfish	Yes		KiTSA 2012
Omnivorous Fish			
Baby goby	Yes		NOAA 2000
Chum salmon	Yes	Chum are anadromous and may utilize the site for only a portion of the year.	KiTSA 2012
Coho salmon	Yes	Coho salmon are anadromous and may utilize the site for only a portion of the year.	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012
Cutthroat trout	Yes	Cutthroat trout are anadromous and may utilize the site for only a portion of the year.	GeoEngineers 2011; Anchor QEA 2012
Green sturgeon	Unlikely	Threatened (Southern DPS; NMFS). Unlikely to be found in Dyes Inlet (Anchor QEA 2012).	Anchor QEA 2012
Gunnel	Yes		NOAA 2000
Herring	Yes	Dyes Inlet supports a small herring stock (Anchor QEA 2012).	Anchor QEA 2012
Pink salmon	Yes	Pink salmon are anadromous and may utilize the site for only a portion of the year.	KiTSA 2012
Sockeye salmon	Yes		
Steelhead trout	Yes	Threatened (Puget Sound DPS4; NMFS). Listed Steelhead are anadromous and may utilize the site for only a portion of the year.	GeoEngineers 2011; Anchor QEA 2012
Sculpin (cabezon, Pacific staghorn, and roughback)	Yes		NOAA 2000
Sand lance	Yes	May serve as prey to salmonids.	GeoEngineers 2011; Anchor QEA 2012
Surf smelt	Yes	May serve as prey to salmonids.	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012

Table 4-1 - Summary of Common Ecological Receptors Potentially Present in Vicinity of the Site

Bremerton Gas Works Superfund Site
Bremerton, Washington

Common Regional Species	Potentially Use of Site (Yes/Unlikely)	Notes	Reference	
Piscivorous Fish				
Bocaccio rockfish	Unlikely	Endangered (Puget Sound/Georgia Basin DPS; NMFS). Rarely observed in Puget Sound (Anchor QEA 2012).	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012	
Bull trout	Unlikely	Threatened (Coastal-Puget Sound DPS4; USFWS). Listed bull trout are anadromous. No bull trout stocks have been identified in any of the streams draining into the larger Sinclair Inlet basin, and no designated critical habitat is present within Kitsap County (Anchor QEA 2012).		
Canary rockfish	Unlikely	Threatened (Puget Sound/Georgia Basin DPS; NMFS). Unlikely to be present at the site due to unsuitable habitat (Anchor QEA 2012).		
Chinook salmon	Yes	Threatened (Puget Sound ESU3; NMFS). Adult Chinook are anadromous and may utilize the site for only a portion of the year.	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012	
Ling cod	Yes		NOAA 2000	
Non-listed rockfish (brown, copper, greenstriped, yellowtail, quillback, black, and yelloweye)	Yes			
Spiny dogfish	Yes			
Yellow rockfish	Unlikely	Threatened (Puget Sound/Georgia Basin DPS; NMFS). Unlikely to be present at the site due to unsuitable habitat (Anchor QEA 2012).	GeoEngineers 2011; Anchor QEA 2012	
Piscivorous Mammals and Other Marine Mammals				
Dall's porpoise	Yes	Puget Sound resident species.	KiTSA 2012	
California sea lion	Yes	Seasonal species.		
Gray whale	Unlikely	Seasonal species. Has been observed in Sinclair Inlet.		
Harbor porpoise	Yes	Species of concern (state). Puget Sound resident species.		
Harbor seal	Yes	Puget Sound resident species. Harbor seals are known to be present in Dyes Inlet (Anchor QEA 2012).		
Humpback whale	Unlikely	Endangered (NMFS). Humpback whales are infrequently observed in Puget Sound (GeoEngineers 2011). Unlikely to be found in Dyes Inlet (Anchor QEA 2012).	GeoEngineers 2011; Anchor QEA 2012	
Killer whale	Unlikely	Endangered (Southern Resident DPS4; NMFS). Listed Orca whales are only present in Puget Sound for a portion of the year (fall/winter). They have been infrequently observed in Dyes Inlet (Anchor QEA 2012).	Anchor QEA 2012; KiTSA 2012	
Minke whale	Unlikely		KiTSA 2012	
Northern sea lion	Yes	Seasonal species.		
River otter	Yes	Puget Sound resident species. Risk to species will be addressed by assessment of piscivorous mammal receptor.		
Stellar sea lion	Unlikely	Species of concern (state). Unlikely to be found in Dyes Inlet (Anchor QEA 2012). Risk to species will be addressed by assessment of piscivorous mammal receptor.	GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012	
Macrophytes				
Algae and kelp	Yes	Aquatic vegetation in Dyes Inlet is patchy (Anchor QEA 2012). Dyes Inlet and Sinclair Inlet do not support any floating kelp (Anchor QEA 2012). Non-floating kelp species are present in just 18% of the shoreline throughout the entire basin (PSP 2005; Anchor QEA 2012). May serve as habitat and food for marine species (KiTSA 2012).	Anchor QEA 2012; KiTSA 2012	
Popweed	Yes		KiTSA 2012	
Sea lettuce	Yes			
Eelgrass	Unlikely	Within Dyes Inlet and Chico Bay there are scattered patches of eelgrass in intertidal areas with muddy to sandy substrates (WDNR 2001; Anchor QEA 2012). Suitable eelgrass habitat is not present at the Site.	Anchor QEA 2012; KiTSA 2012	
Terrestrial Species				
Avian Predator				
Black-capped Chickadee	Yes		KiTSA 2012	
Crow	Yes			
Evening grosbeak	Yes			
Flicker	Yes			
Golden-crowned kinglet	Yes			
Purple martin	Yes			Species of concern (state)
Ring-necked pheasant	Yes			
Robin	Yes			
Starling	Yes			
Steller's jay	Yes			
Carnivorous Mammals				
Coyote	Yes	Unlikely to be present at the site due to unsuitable habitat.	KiTSA 2012	
Fox	Unlikely			
Lynx	Unlikely			

Table 4-1 - Summary of Common Ecological Receptors Potentially Present in Vicinity of the Site

Bremerton Gas Works Superfund Site
Bremerton, Washington

Common Regional Species	Potentially Use of Site (Yes/Unlikely)	Notes	Reference
Herbivorous Mammals			
Deer	Unlikely	Unlikely to be present at the site due to unsuitable habitat.	KiTSA 2012
Rabbits	Yes		
Squirrels	Yes		
Vole	Yes		
Insectivorous Mammal			
Shrews	Yes		
Omnivorous Mammals			
Black bear	Unlikely	Unlikely to be present at the site due to unsuitable habitat.	KiTSA 2012
Mice	Yes		
Moles	Yes		
Raccoon	Yes		
Other Miscellaneous Fauna			
Garter snakes	Yes	Habitat at the site includes the upland embankment and unpaved upland site areas.	KiTSA 2012
Newts and frogs	Unlikely	Amphibians are not likely to be present at the site due unsuitable habitat.	
Salamanders	Unlikely	Amphibians are not likely to be present at the site due unsuitable habitat.	
Turtles	Unlikely	Turtles are not likely to be present at the site due to unsuitable habitat.	
Upland Vegetation			
Big leaf maple	Yes	Native vegetation. Limited in developed site areas.	KiTSA 2012
Douglas fir	Yes		GeoEngineers 2011; KiTSA 2012
Kinnikinnick	Yes		KiTSA 2012
Oregon grape	Yes		
Pacific madrone	Yes		
Pacific rhododendron	Yes		
Pacific gumweed	Yes		GeoEngineers 2011
Red alder	Yes		GeoEngineers 2011; Anchor QEA 2012
Salal	Yes		KiTSA 2012
Sword fern	Yes		
Vine maple	Yes		
Western hemlock	Yes		
Western red cedar	Yes		
Japanese knotweed	Yes	Non-native species.	Anchor QEA 2012
Himalayan blackberry	Yes		GeoEngineers 2011; Anchor QEA 2012; KiTSA 2012
Magnolia	Yes		GeoEngineers 2011
Pampas grass	Yes		
Scotch broom	Yes		GeoEngineers 2011; KiTSA 2012
Spear saltbrush	Yes		GeoEngineers 2011
Thistle	Yes		KiTSA 2012

Notes:

Underlined = Representative species included as part of ecological A31CSM figures.

Anchor QEA, 2012. *Biological Evaluation*. Chico Creek Estuary Restoration Project. January 2012.

Buchanan, J.B., 2006. *Nearshore Birds in Puget Sound*. Puget Sound Nearshore Partnership. Report number 2006-05. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

DPS = distinct population segment

ESU = evolutionary significant unit

GeoEngineers, 2011. *Biological Assessment*. Bay Street Pedestrian Enhancement/Mosquito Fleet Trail Project. LSTPE-0166 (008). Port Orchard, Washington. Prepared for City of Port Orchard. August 26, 2011.

KiTSA (Kitsap Trees and Shoreline Association), 2012. Sinclair Inlet Development Concept Plan. Sponsored by KiTSA.

NMFS = National Marine Fisheries Service

NOAA (National Oceanic and Atmospheric Administration), 2000. Gustafson R.G., W.H. Lenarz, B.B. McCain, C.C. Schmitt, W.S. Grant, T.L. Builder, and R.D. Methot. 2000. Status review of Pacific Hake, Pacific Cod, and Walleye Pollock from Puget Sound, Washington. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC- 44, 275 p.

PSP (Puget Sound Partnership), 2005. Regional Nearshore and Marine Aspects of Salmon Recovery. June 2005.

USFWS = U.S. Fish and Wildlife Service

WAC = Washington Administrative Code

WDNR (Washington Department of Natural Resources), 2001. WDNR and Puget Sound Assessment and Monitoring Program Shore Zone data set. Nearshore Habitat Program.

Threatened and endangered species will be re-evaluated at the time of the risk assessment.

Table 4-2 - Nationwide MGP Site Summary

Bremeton Gas Works Superfund Site
Bremerton, Washington

MGP Site Name & Location	Reference	Geologic Conditions	Groundwater / Surfacewater	Chemicals of Concern	Remedial Actions	Cleanup Status
Cold Spring MGP Site Cold Spring, NY	Record of Decision (2010) http://www.dec.ny.gov/docs/remediation_hudson_pdf/e340026arod.pdf	<ul style="list-style-type: none"> Subsurface soils consist of 11-13 feet of debris containing fill underlain by a 15 foot thick layer of clay, which overlies bedrock. Contamination confined to the fill material. 	<ul style="list-style-type: none"> Groundwater flows to the west, towards the Hudson River which is adjacent to the site. No contamination was observed in river sediments. 	<p>BTEX</p> <p>PAHs</p>	Excavation and off-site treatment/disposal.	Scheduled to begin late 2014
Saranac Street MGP Site Plattsburgh, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/rod51000701.pdf	<ul style="list-style-type: none"> Subsurface soils consist of up to 21 feet of debris containing fill underlain by up to 15 foot thick layer of sandy alluvium. Beneath the alluvium lies a layer of dense glacial till, which overlies limestone bedrock. Contamination present down to and into fractured bedrock. 	<ul style="list-style-type: none"> The Saranac River forms the southern, western, and northern site boundary. Coal tar discharged into the river along the northwestern and norther site boundaries. 	<p>BTEX</p> <p>PAHs</p>	<p><i>In situ</i> stabilization;</p> <p>Soil and sediment excavation with off-site treatment/disposal;</p> <p>Bedrock tar collection wells.</p>	Remedial Action complete
Waterville MFG Plant Waterville, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/533041_1.pdf	<ul style="list-style-type: none"> Subsurface soils consist of one foot of topsoil over a fill unit up to 12 feet thick consisting of a substantial amount of ash as well as brown sand and gravel, coal fragments and bricks. Below the fill is a unit of glacial outwash sand and silt ranging in thickness from 1 to 10 feet. A dense kame moraine silt and gravel deposit of depths from 4 to 12 feet was found below the outwash unit. Contamination present up to 14 feet below grade. 	<ul style="list-style-type: none"> A western flowing tributary to Big Creek forms the southern edge of the property, approximately 150 feet south of the site. The depth to groundwater ranges from approximately 4 to 12 feet below grade. Groundwater flow through the site is to the south-southwest and discharges into the Big Creek tributary. 	<p>BTEX</p> <p>PAHs</p>	Excavation and Disposal; Institutional Controls; Soil Cap.	No Further Action required
Cortland Homer Former MGP Site Homer, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/rod712005.pdf	<ul style="list-style-type: none"> Subsurface soils consist of a fill layer ranging from 6 inches to 10 feet and is underlain by outwash sand that varies in thickness from 20 to 40 feet. A confining silt/clay layer was observed beneath the outwash sand. Contamination present up to 37 feet below grade. 	<ul style="list-style-type: none"> The West Branch of the Tioughnioga River is located 150 feet east of the site parcels. Depth to groundwater at the site is approximately 5 feet below grade. Groundwater flow is in a east to east-southeast direction. Groundwater discharges into the river. River sediments have been impacted by contaminants. 	<p>BTEX</p> <p>PAHs</p> <p>Cyanide</p>	<p>Excavation and disposal of source area soils;</p> <p><i>In situ</i> stabilization of downgradient contaminated soils;</p> <p>NAPL collection trench;</p> <p>Sediment removal.</p>	Remedial Design complete

Table 4-2 - Nationwide MGP Site Summary

Bremerton Gas Works Superfund Site
Bremerton, Washington

MGP Site Name & Location	Reference	Geologic Conditions	Groundwater / Surfacewater	Chemicals of Concern	Remedial Actions	Cleanup Status
Tacoma Tar Pits Tacoma, WA	http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/TacomaTarPits/\$FILE/TTP-5Yr-Review-Sept03.pdf	<ul style="list-style-type: none"> Subsurface soils consist of several feet of fill underlain by a layered sequence of silts and sands. 	<ul style="list-style-type: none"> The Puyallup River is just northeast of the site. Groundwater occurs several feet below ground surface at the Tacoma Tar Pits site. The groundwater levels at the site vary in response to the tidal action in Commencement Bay and adjacent waterways. Groundwater flow directions vary depending on location, season, and tide stage. In general however, groundwater typically flows east (northwest and central portions of the site) and south (southeast portion of the site). 	BTEX PAHs	Excavation and stabilization; Stabilized material placed in an engineered waste pile on site; Soil cap; Groundwater pump and treat.	Ongoing O&M for cover and groundwater treatment system
Oakland MGP Oakland, CA	http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=01490012	<ul style="list-style-type: none"> Subsurface soils consisting of up to 5 feet of gravel/sand fill underlain by a sandy layer that extends up to 15 feet below grade with interbedded layers of silt and clay. The sandy layer is underlain by a fine-grained layer of clay and silt up to 20 feet below grade. Contamination present up to 21 feet below grade. 	<ul style="list-style-type: none"> Groundwater is 2 to 7.5 feet bgs and flows towards the Oakland Inner Harbor, which is approximately 1000 feet away. 	TPH BTEX PAHs Cyanide	Soil cap.	Ongoing O&M
Glens Falls - Mohican Street MGP Glens Falls, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/557016roda2.pdf	<ul style="list-style-type: none"> Subsurface soil consists of fill underlain by glacial fluvial deposits of sand, silt, silty sand, sandy silt. A layer of silty clay overlies bedrock, which is encountered between 9-29 feet below grade. Contamination present up to 19 feet below grade. 	<ul style="list-style-type: none"> The site is bounded to the south by the Glens Falls feeder canal. Groundwater is 2-14 feet below grade and flows towards the Glens Falls canal and Hudson River. Canal sediments are impacted. 	BTEX PAHs	Excavation of source material; Oxygen delivery system; Soil cover; Institutional controls; Dredging and disposal.	Remedial Action approved
Gastown MGP Site Tonawanda, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/rod915171text.pdf http://www.dec.ny.gov/chemical/58387.html	<ul style="list-style-type: none"> Subsurface soils consist of up to 22 feet of debris containing fill underlain by layers of sand and silt for an additional 24 feet below grade. Contamination present down into the sand/silt layers. 	<ul style="list-style-type: none"> The site is bounded to the north-northwest by Tonawanda Creek. Groundwater is approximately 6 feet below grade and flows to the north into Tonawanda Creek. Creek sediments have been impacted. 	BTEX PAHs	Excavation and disposal; <i>In situ</i> stabilization; NAPL collection wells.	Scheduled to begin in 2013
Former Sacramento MGP Sacramento, CA	http://www.pge.com/about/environment/taking-responsibility/mgp/sacramento.shtml	<ul style="list-style-type: none"> Subsurface soils consist of up to 15 feet of fill underlain by a layer containing mostly silts and clayey silts to 25 feet below grade. A layer of unconsolidated sand extends from approximately 25 feet to 85 feet below grade. Contamination present up to 45 feet below grade. 	<ul style="list-style-type: none"> The site is located adjacent to the Sacramento River. Groundwater is present approximately 18 feet below grade and flow is strongly influenced by the Sacramento River and flows to the east. 	TPH BTEX PAHs	Excavation and disposal; Pump and treat; <i>In situ</i> stabilization.	<i>In situ</i> stabilization implemented late 2012
Former Red Bluff MGP Red Bluff, CA	http://www.pge.com/about/environment/taking-responsibility/mgp/red-bluff.shtml	<ul style="list-style-type: none"> Subsurface soil consists of up between 3 and 28 feet of debris containing fill material underlain by a silty clay / clayey silt with interbedded sand, gravel, and finer-grained sediments. Contamination present in the fill material. 	<ul style="list-style-type: none"> The site is bound to the east by the Sacramento River. Groundwater is present between 4 and 39 feet below grade and is heavily influenced by river level. Groundwater flows either east, or west, depending on river stage. 	TPH BTEX PAHs	Excavation and disposal of shallow source soils; <i>In situ</i> stabilization of deeper source soils.	Remedial Action approved

Table 4-2 - Nationwide MGP Site Summary

Bremeton Gas Works Superfund Site
Bremerton, Washington

MGP Site Name & Location	Reference	Geologic Conditions	Groundwater / Surfacewater	Chemicals of Concern	Remedial Actions	Cleanup Status
Georgia MGP	http://www.geiconsultants.com/stuff/contentmgr/files/0/50b92d14438556ba3621879700e41ab4/download/insitustabilization.pdf	<ul style="list-style-type: none"> •Subsurface soil consists of up to 22 feet of fill underlain by 15 feet of alluvium above weathered bedrock. •Contamination present to the bedrock. 	The site is bounded to the west by the Chattahoochee River.	BTEX PAHs	<i>In situ</i> stabilization; Excavation and disposal; Groundwater barrier.	Remedial Action complete
Nyack MGP Site Nyack, NY	http://www.dec.ny.gov/docs/remediation_hudson_pdf/rod34404601.pdf	<ul style="list-style-type: none"> •Subsurface soil consists of up to 13 feet of fill underlain by native silty sand and glacial till layers. Sandstone bedrock was encountered approximately 40 feet below grade. •Contamination present to the bedrock. 	<ul style="list-style-type: none"> •The site is bound to the north by the Hudson River. •The bedrock is a productive aquifer with the groundwater flowing upward through the bedrock. Groundwater generally flows toward the Hudson River. •River sediments have been impacted. 	BTEX PAHs	Excavation and disposal; <i>In situ</i> stabilization; <i>In situ</i> chemical oxidation; Dredging and disposal.	Upland solidification complete. Sediment removal scheduled to begin in 2013
Manitowoc Former MGP Site Manitowoc, WI	http://www.epa.gov/region05/cleanup/manitowoc/pdfs/manitowoc-completion-report-20070725.pdf	<ul style="list-style-type: none"> •Subsurface soil consists of 3-10 feet of miscellaneous sand/silt/clay fill material overlying glacial deposits of sand with varying amounts of gravel, silt, and clay. Unconsolidated materials extend to at least 40 feet below ground and bedrock is estimated to be approximately 48 to 50 feet below grade. •Contamination present up to 27 feet below grade. 	<ul style="list-style-type: none"> •The site is bound to the northwest by the Manitowoc River. •Groundwater is present between 5 and 22 feet below grade and flows towards the Manitowoc River. •River sediments have been impacted. 	BTEX PAHs Cyanide	Shallow excavation and disposal; <i>In situ</i> stabilization; Pump and treat (carbon); <i>In situ</i> stabilization for sediments failed; Dredging.	Pump and Treat O&M Sediment dredging scheduled to begin December 2013
Kinston MGP Site Kinston, NC	http://www.neuselibrary.org/Kinston%20MGP%20Remedial%20Action%20Plan.pdf	<ul style="list-style-type: none"> •Subsurface soils consist of gravel fill underlain by a fine to medium grained sand layer with some gravel and clay up to 21 feet below grade. The sandy layer is underlain by a silt/clay which extends up to 45 feet below grade, followed by a silty sand extending to 55 feet below grade. •Contamination present up to 23 feet below grade. 	<ul style="list-style-type: none"> •The Neuse River borders more than 50% of the Site including the north, west, and southwest boundaries. •Groundwater flow is to the southwest, towards the Neuse River. •River sediments have been impacted. 	BTEX PAHs Cyanide	<i>In situ</i> stabilization; Institutional controls.	Remedy selected, awaiting implementation

Notes:

BTEX = benzene, toluene, ethylbenzene, and xylenes

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

MGP = manufactured gas plant

NAPL = non-aqueous phase liquid

O&M = operation and maintenance

PAHs = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

Table 4-3 - Summary of Preliminary Contaminants of Potential Concern

Bremerton Gas Works Superfund Site

Bremerton, Washington

Contaminant Group	Reason for Inclusion					Potential Sources of MGP Related Contaminants (see Note 1)									Potential Human Health and Environmental Concerns (see Note 2)		
						Feedstocks and Fuels			MGP Process Byproducts								
	Potential MGP Related Constituents	Other Sources (see Note 3)	Detected in Previous Sampling Efforts	Detected Above Initial PRGs	Insufficient Data to Exclude	Gasoline	Diesel fuel oil	Coal/coke briquettes	Ash, clinker, cinder, slag, soot, bricks	Spent scrubber media (tarry wood chips)	Tar (potentially as DNAPL)	Light oil (potentially as LNAPL)	Gas Liquor and Emulsion (tar water mixture)	Spent purifier media (iron oxide, tarry wood chips)	Human Health Risk (Carcinogen)	Other Human Health Risks (non Carcinogen)	Toxicity to Ecological Receptors
VOCs	X	X	X	X		X				X	X	X	X	X	X	X	X
PAHs	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
SVOCs	X	X	X	X						X	X		X	X	X	X	X
Metals		X	X	X											X	X	X
PCBs ⁴					X										X	X	X
Pesticides ⁴					X										X	X	X
Dioxins/Furans ⁴					X										X	X	X
Cyanide, WAD	X													X		X	X
Cyanide, total	X													X		X	X
Sulfide	X																X

Notes

1) Contaminants of Potential Concern (COPCs) associated with MGP sources based on typical composition of MGP related feedstocks and byproducts (see Section 2.3.1.1).

2) Potential Human Health and Environmental Concerns identified based on whether risk based screening levels or potential ARARs for human health (carinogenic health effects), human health (non carcinogenic health effects), or ecological health effects were identified during development of initial Preliminary Remediation Goals (PRGs) (see Section 3.1.3).

3) Other Sources include other historical operations at the site or regional sources of contamination.

4) Included as preliminary COPCs based on EPA's requirement that samples at the beginning of this RI/FS need to be analyzed using a full suite of methods.

Table 4-3

Final RI/FS Work Plan

5/18/2017

V:\080239 Bremerton Former MGP Site\Deliverables\AOC DELIVERABLES\RI FS Workplan\May 2017 Final\Tables\Table 4-3 Preliminary COPCs

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Table 5-1 - Summary of Existing Information and Data Gaps - Uplands

Bremerton Gas Works Superfund Site
Bremerton, Washington

Remedial Investigation/Feasibility Study Information Needs by Topic	Existing Information	Data Gaps	Recommended Data Collection
Physical Characteristics			
Characteristics of water-bearing zones	Soil stratigraphy and observed/measured groundwater occurrence from previous investigations identifies a water-bearing zone in clean to silty glacial sands at depths of 15 to 41 feet below surface.	<ul style="list-style-type: none">• Measured/tested physical properties of soil comprising water-bearing zones and aquitards.• Hydraulic conductivity of water-bearing zones and aquitards.• Vertical extent of the shallow water-bearing zone• Presence, location and nature of aquitards.• Presence, location and nature of deeper water-bearing zones.	<ul style="list-style-type: none">• Soil borings to evaluate soil stratigraphy and identify water-bearing zones and aquitards.• Soil samples from borings for laboratory measurement of physical parameters that may include grain size, porosity, bulk density, and total/fraction organic carbon.• Slug tests at select site wells to measure hydraulic conductivity in each saturated stratigraphic horizon and in different water-bearing zones (if applicable).
Groundwater flow direction and gradient	Manual groundwater level measurements collected at eight wells in 2007 were used to evaluate groundwater flow direction and gradient.	<ul style="list-style-type: none">• Groundwater flow direction and horizontal/vertical gradients.• Seasonal variability in water levels and groundwater gradients.• Influence of precipitation/surface water infiltration on groundwater levels.• Influence of tidal fluctuation on groundwater levels.	<ul style="list-style-type: none">• Continuous water levels at site wells and in the Narrows using pressure transducers.• Precipitation amounts recorded at area weather stations.
Groundwater geochemistry	None.	<ul style="list-style-type: none">• Location of salt water intrusion and extent of groundwater-surface water interaction.	<ul style="list-style-type: none">• Groundwater samples will be collected from site wells for field measurements and laboratory analysis of conventional geochemical parameters, salinity.
Nature and Extent of Contamination			
Identify and evaluate source areas	Historical review of Gas Works operations identifies potential source areas.	<ul style="list-style-type: none">• Potential sources and source areas have not been sufficiently investigated.• Potential locations of some potential sources (e.g., tar pits, transfer piping) are unknown or roughly estimated.• Lateral and vertical extent of sources in the subsurface is unknown.	<ul style="list-style-type: none">• Geophysical surveys to identify potential subsurface features.• Advance soil borings and complete test pits or trenches in and around potential source areas including former process and residuals management areas: tar pit, residue cistern, tar wells; in the ravine fill area; and at a geophysical anomalies detected during geophysical surveys indicating a potential source.• Visually observe and record soil stratigraphy and indications of contamination.
Evaluate COPCs to determine COCs	Surface and subsurface soil and groundwater samples collected in 2007 and 2008 were analyzed for metals, petroleum hydrocarbons, SVOCs, VOCs and PCBs.	<ul style="list-style-type: none">• Presence of COPCs previously not evaluated (e.g., cyanide).• COPC analysis of sources and in areas not previously characterized.	<ul style="list-style-type: none">• Samples during the intial investigation phases will be analyzed for all of the COPCs.• Soil and groundwater samples collected throughout the investigation will be used in the risk assessment to identify COCs for evaluation of remedial options in the Feasibility Study.
Define nature and extent of COCs in soil	Soil samples collected in 2007 and 2008 identified concentrations of metals, PAHs, and VOCs exceeding PRGs.	<ul style="list-style-type: none">• Current nature and extent of COCs in soil.• Presence, nature and extent of COPCs previously not evaluated.	<ul style="list-style-type: none">• Soil samples will be collected from soil borings, test pits or trenches in and downgradient of source areas, and soil samples using ISM will be collected from soil borings outside source areas, to establish horizontal and vertical limits to the extent of comtamination. Soils will be submitted for chemical analysis of COPCs.

Table 5-1 - Summary of Existing Information and Data Gaps - Uplands

Bremerton Gas Works Superfund Site
Bremerton, Washington

Remedial Investigation/Feasibility Study Information Needs by Topic	Existing Information	Data Gaps	Recommended Data Collection
Define nature and extent of COCs in groundwater	Groundwater samples collected in 2007 and 2008 identified concentrations of metals, SVOCs, and VOCs exceeding PRGs.	<ul style="list-style-type: none">• Current nature and extent of COCs in groundwater.• Seasonal variability of COCs in groundwater.• Presence, nature and extent of COPCs previously not evaluated.	<ul style="list-style-type: none">• Install monitoring wells to evaluate impacts in source areas and establish horizontal and vertical limits to the extent of contamination. Groundwater samples will be initially be collected from all monitoring wells for chemical analysis of all COPCs. A quarterly sampling program will be determined based on initial results.
Define nature and extent of NAPL	Previous investigations have indicated that NAPL may be present.	<ul style="list-style-type: none">• Presence/absence of NAPL• Chemical composition of NAPL• Lateral and vertical boundaries of NAPL occurrences	<ul style="list-style-type: none">• Advance soil borings and complete test pits or trenches in former Gas Works operations and residuals management areas, including the tar pit, residue cistern, tar wells, and in the ravine fill area. Visually observe and record soil stratigraphy and NAPL occurrences.• Include monitoring wells screened appropriately to monitor LNAPL (across water table) and DNAPL (above aquitards). Monitor wells for LNAPLs and DNAPL presence.• Submit samples of soil and/or NAPL collected from soil borings, test pits, trenches or wells for chemical analysis to characterize NAPL chemistry.• If NAPL is identified to be present: advance additional soil borings for deeper NAPL occurrences and test pits or trenches for shallow NAPL occurrences in areas requiring more precise definition of NAPL occurrences.
Evaluate potential for recontamination from other area sites	Soil and groundwater samples have been collected from borings and wells located upgradient of the Gas Works property show potential impacts in groundwater south of the property. Limited available data do not show impacts from bulk fuel facilities east of Pennsylvania Avenue or west of Thompson Drive extending onto the Gas Works Property.	<ul style="list-style-type: none">• Potential impact from adjacent bulk fuel facilities and upgradient industrial sites.	<ul style="list-style-type: none">• Soil and groundwater data collected from soil borings, test pits and monitoring wells upgradient of the former Gas Works property will be compared to evaluate the extent of contaminants exceeding screening criteria that are associated with the Gas Works site and potential contributions from other area contaminant sources.
Contaminant Fate and Transport			
NAPL migration pathways	NAPL may be present in the subsurface. MGP-related products include both LNAPL and DNAPL.	<ul style="list-style-type: none">• Nature and extent of NAPL (see above)• NAPL mobility, including NAPL physical characteristics and soil lithology/physical properties	<ul style="list-style-type: none">• Characterize soil characteristics, NAPL characteristics and extent (see above).• Recovery testing to evaluate potential mobility, if NAPL observed in monitoring wells.
Soil-to-groundwater pathway	Concentrations of Gas Works-associated constituents have been detected above soil and groundwater PRGs.	<ul style="list-style-type: none">• Leaching potential from contaminated soils.	<ul style="list-style-type: none">• Include TOC in soil testing program.• Collect data to evaluate chemical and geochemical groundwater quality along groundwater transects, located parallel to the groundwater flow direction, to evaluate groundwater conditions with distance from sources.

Table 5-1 - Summary of Existing Information and Data Gaps - Uplands

Bremerton Gas Works Superfund Site
Bremerton, Washington

Remedial Investigation/Feasibility Study Information Needs by Topic	Existing Information	Data Gaps	Recommended Data Collection
Soil-to-surface water pathway	Concentrations of Gas Works-associated constituents have been detected above soil PRGs.	• Discharge of contamination through stormwater runoff.	• Characterize contamination in sediment and surface water near outfalls.
Groundwater-to-surface water pathway	Concentrations of Gas Works-associated constituents have been detected in groundwater above surface water PRGs.	• Groundwater transport parameters (velocity, pathway). • Attenuation parameters.	• Include natural attenuation parameters in groundwater testing program. • Characterize hydrogeology and chemical nature and extent (see above). Data may be incorporated into hydrogeologic and fate and transport models. • Groundwater monitoring program to assess seasonal variability and long-term trends.
Soil-to-air and groundwater-to-air pathway	Concentrations of Gas Works-associated constituents have been detected above current soil and groundwater PRGs.	• Potential impacts to future indoor air.	• Soil and groundwater data to be used with vapor transport modeling.
Human Health and Ecological Risk Assessment			
Assess potential receptors and exposure pathways	Concentrations of Gas Works-associated constituents have been detected above current soil and groundwater criteria.	• Soil and groundwater data to calculate representative exposure point concentrations for human and ecological receptors.	• Soil and groundwater chemical analytical results will be compared to human health and ecological risk-based criteria.

Notes:

BTEX = benzene, toluene, ethylbenzene and xylenes

COC = chemical of concern

COPC = chemical of potential concern

Cs-137 = Cesium 137 isotope

CSL = Cleanup Screening Level

CSO = combined sewer overflow

ISM = incremental sampling methodology

LNAPL = light non-aqueous phase liquide

MGP = manufactured gas plant

NAPL = non-aqueous phase liquid

NOAA: National Oceanic and Atmospheric Administration

PAHs = Polycyclic aromatic hydrocarbons

PRG = preliminary remediation goal

SCO = Sediment Cleanup Objective

SMS = Washington Sediment Management Standards regulations (WAC-173-204)

TOC = total organic carbon

VOC = volatile organic compound

Table 5-2 - Summary of Existing Information and Data Gaps - Sediments

Bremerton Gas Works Superfund Site
Bremerton, Washington

RI/FS Information Needs by Topic (What We Need to Know)	Existing Information (What We Already Know)	Data Gaps (What We Don't Know)	Recommended Data Collection (RI Work to Fill Data Gaps)
Nature and Extent of Contamination			
Assess presence of chemical contaminants associated with historical MGP operations	<ul style="list-style-type: none">• MGP operational history is well documented.• MGP-associated contaminants typically include PAH compounds, selected VOCs (i.e., BTEX compounds), cyanide and dibenzofuran.• Surface sediment PAH concentrations within the intertidal beach areas have been extensively sampled.• Some testing for other parameters (semivolatiles, metals and VOCs) has also been performed on a more limited basis.	<ul style="list-style-type: none">• Sampling has not yet been performed in areas offshore of the former MGP dock.• Testing has not been performed for cyanide in sediments.• Testing for alkylated PAHs has not been performed (these parameters are useful in discriminating PAH sources in sediments).	<ul style="list-style-type: none">• Collect surface sediment samples from MGP dock area• Analyze sediment samples for Site COPCs and alkylated PAH to document the "fingerprint" of MGP-associated PAHs
Identify chemical contaminants potentially associated with other historical activities within the Site	<ul style="list-style-type: none">• Other potentially significant uses of the Site and vicinity include ravine fill, oil handling, CSO/stormwater discharges, adjacent marina operations and miscellaneous industrial operations on the Sesko and McConkey properties.• Some testing for other parameters besides PAH compounds (semivolatiles, metals and VOCs) has been performed on a limited basis.	<ul style="list-style-type: none">• Sampling near non-MGP sources is not sufficient to finalize list of COPCs• Testing has not yet been performed offshore of former Sesko Oil dock• Testing for alkylated PAHs has not been performed (these parameters are useful in discriminating PAH sources in sediments)	<ul style="list-style-type: none">• Collect surface sediment samples from former Sesko dock area• Analyze sediment samples for Site COPCs and alkylated PAH to document the "fingerprint" of MGP-associated PAHs
Define the lateral extent of Site COPCs in surface sediment	<ul style="list-style-type: none">• Surface sediment PAH concentrations within the intertidal beach areas have been extensively sampled.• Some testing for other parameters (semivolatiles, metals and VOCs) has also been performed on a more limited basis.	<ul style="list-style-type: none">• The lateral extent of Site COPCs has not been determined	<ul style="list-style-type: none">• Collect surface sediment samples from across the initial study area and analyze for Site COPCs and alkylated PAHs
Define the vertical extent of Site COPCs in sub-surface sediment, including the potential presence of subsurface hydrocarbon deposits (i.e., sheen or NAPL)	<ul style="list-style-type: none">• Limited subsurface testing has been performed in the western portion of the intertidal beach to evaluate the vertical extent of PAH contamination and hydrocarbon sheen in that area. Results demonstrated that sediment contamination levels decreased rapidly with depth, and the area containing subsurface hydrocarbon sheen was very limited.	<ul style="list-style-type: none">• Subsurface testing has not been performed in other areas of the beach. The depth of contamination is therefore not defined in those areas.• No surface or subsurface testing has been performed areas offshore of the former MGP dock.• Core sampling data are not yet sufficient to assess whether subsurface hydrocarbon deposits (sheen or NAPL) may be present in subsurface sediments other than in the western beach area.	<ul style="list-style-type: none">• Conduct sediment core sampling and chemical analysis within the initial study area to assess the vertical extent of Site COPCs• Include sufficient core sampling locations in nearshore and offshore areas to assess the potential presence of susurface hydrocarbon deposits (sheen or NAPL).

Table 5-2 - Summary of Existing Information and Data Gaps - Sediments

Bremerton Gas Works Superfund Site
Bremerton, Washington

RI/FS Information Needs by Topic (What We Need to Know)	Existing Information (What We Already Know)	Data Gaps (What We Don't Know)	Recommended Data Collection (RI Work to Fill Data Gaps)
Human Health & Ecological Risk Assessment			
Assess the site-specific partitioning behavior of PAHs in sediments	<ul style="list-style-type: none">Literature data can be used to estimate potential partitioning of PAH compounds between sediment and pore-water. However, these methods may not capture site-specific factors.	<ul style="list-style-type: none">No site-specific pore-water testing has been performed to assess PAH partitioning behavior in sediments	<ul style="list-style-type: none">Conduct paired analysis of bulk sediment and pore-water PAH concentrations in selected study areas for analysis of site-specific partitioning behavior.
Assess potential impacts of Site COPCs to benthic receptors	<ul style="list-style-type: none">The potential for benthic impacts can be assessed using bulk sediment chemistry (to be defined as described above) along with toxicity threshold values such as the SMS SCO and CSL values, and/or the EPA narcosis toxicity model.Pore-water PAH data may be used directly to assess potential benthic toxicity using the EPA narcosis toxicity model.	<ul style="list-style-type: none">Site-specific bioassay testing could be used along-side bulk sediment chemistry and pore-water testing data to assess potential benthic impacts.The need for bioassay testing can be assessed after review of bulk sediment chemistry and pore-water PAH data to be collected as described above.	<ul style="list-style-type: none">Contingent Activity: If applicable, based on review of bulk sediment chemistry and pore-water testing data, collect sediment samples from selected areas for confirmational bioassay testing. This testing could be used to verify predicted impacts and refine the lateral extent of those impacts.
Assess potential for Site-associated sediment contaminants to accumulate in the tissues of aquatic organisms	<ul style="list-style-type: none">Literature data can be used to estimate potential uptake of PAH or other contaminants in the tissues of aquatic organisms. Reliance on literature data may not capture site-specific factors.	<ul style="list-style-type: none">No site-specific tissue testing data or bioaccumulation testing data has been performed	<ul style="list-style-type: none">Develop estimates of tissue concentrations based on bulk sediment and pore-water testing data and literature-based biota-sediment accmulation factors.Devise strategy for collection of appropriate marine tissue samples in consultation with EPA and the Tribe.
Document the types and quantities of aquatic species present in the vicinity of the Site	<ul style="list-style-type: none">Previous habitat and fish/shellfish resource surveys have been performed in the Port Washington Narrows and Dyes inlet areas, documenting locally-abundant fish and shellfish species.Information regarding current and proposed shellfish growing areas, and historical patterns of fishing and shellfish harvesting are available through state and tribal agencies.Patterns of tribal seafood consumption have been identified in previous surveys of the Suquamish, Tulalip and Squaxin nations.	<ul style="list-style-type: none">Additional information is required to document the habitat conditions and the types of seafood species present within the ISA and immediate vicinity.	<ul style="list-style-type: none">Conduct baseline shellfish surveys of aquatic habitat and fish/shellfish resources within ISA and immediate vicinity
Evaluate potential Site-associated water quality impacts as necessary to support exposure assessments in the human health and ecological risk assessments	<ul style="list-style-type: none">No surface water data are currently available for the Site.Regional studies have documented anthropogenic surface water contaminant inputs to Port Washington Narrows and Dyes Inlet, including but not limited to stormwater and CSO discharges. Any Site-specific sampling of surface water quality will need to consider potential off-site sources for measured water quality parameters.	<ul style="list-style-type: none">Surface water quality for the Site and vicinity are not currently available as required to support the risk assessment data needs.	<ul style="list-style-type: none">Analyze surface water samples for Site COPCs. Samples to be collected from both within the initial study area and at selected background stations within Port Washington Narrows east and west of the Site to provide ambient water quality context.

Table 5-2 - Summary of Existing Information and Data Gaps - Sediments

Bremerton Gas Works Superfund Site
Bremerton, Washington

RI/FS Information Needs by Topic (What We Need to Know)	Existing Information (What We Already Know)	Data Gaps (What We Don't Know)	Recommended Data Collection (RI Work to Fill Data Gaps)
Sediment Stability and Recovery Processes			
Assess potential near-bottom currents effects on long-term sediment stability and sediment transport processes within the Site and immediate vicinity.	<ul style="list-style-type: none">• Peak tidal currents within Port Washington Narrows are understood from existing studies (e.g., NOAA tide and current data).• Sediment texture and particle size will be defined during surface sediment testing as described above.	<ul style="list-style-type: none">• Near-bottom tidal currents can be significantly different than open-water, mid-channel currents due to local and edge effects. No near-bottom current data is available for the Site or vicinity.	<ul style="list-style-type: none">• Conduct empirical measurements of near-bottom and mid-channel tidal currents for use in an analysis of sediment stability and evaluation of sediment transport proceses.
Quantify sedimentation rates to assess the degree of natural recovery that may be anticipated	<ul style="list-style-type: none">• Geochronology studies have been performed in several areas of Puget Sound, documenting a general pattern of sedimentation.	<ul style="list-style-type: none">• Sedimentation rates can vary with location. No sedimentation rate data are available for Port Washington Narrows areas near the Site.	<ul style="list-style-type: none">• Contingent Activity: If warranted, quantify net sedimentation rates near the Site using geochronology test methods (i.e., thin-section cores analyzed with Cs-137 radio-dating).

Notes:
BTEX = Benzene, toluene, ethylbenzene, and xylenes
COC = Contaminant of Concern
Cs-137 = Cesium 137 isotope
CSL = Cleanup Screening Level
CSO = combined sewer overflow
EPA = U.S. Environmental Protection Agency
MGP = manufactured gas plant

NAPL = nonaqueous product layer
NOAA = National Oceanic and Atmospheric Administration
PAH = polynuclear aromatic hydrocarbon
RI/FS = Remedial Investigation/Feasibility Study
SCO = Sediment Cleanup Objective
SMS = Washington Sediment Management Standards regulations (WAC-173-204)
VOC = volatile organic compound

Table 5-3 - Risk Assessment Plan, Baseline Human Health Risk Evaluation

Bremerton Gas Works Superfund Site

Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Subsistence consumer of fish/crab	Dietary TDI will be estimated from dietary consumption of fish and crab, incidental sediment, and surface water. TDI estimates will be developed using EPA tribal framework. Finfish to include finfish tissue from relevant species from Suquamish Group D (halibut, sole, flounder, and rockfish).	Concentrations of chemicals in tissues, surface sediment (intertidal and subtidal), and surface water. In addition to the use of tissue concentrations, bulk sediment data will be used along with applicable BSAFs to estimate chemical concentrations in fish and crab tissue.	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Applicable toxicity and exposure parameters	Collection of site-specific tissue will be scoped and detailed in the Risk Assessment Technical Memorandum (Section 5.3.1).
Subsistence consumer of shellfish ⁴	TDI will be estimated from dietary consumption of shellfish (i.e., clams), incidental sediment, and surface water. TDI estimates will be developed using EPA tribal framework.	Concentrations of chemicals in tissues, intertidal surface sediment, and surface water. In addition to the use of tissue concentrations, bulk sediment data will be used along with applicable BSAFs to estimate chemical concentrations in shellfish tissue.	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Applicable toxicity and exposure parameters	Collection of site-specific tissue will be scoped and detailed in the Risk Assessment Technical Memorandum (Section 5.3.1).
Recreational beach user	TDI will be estimated from dermal contact and incidental ingestion of sediment and surface water.	Concentrations of chemicals in intertidal surface sediment and surface water.	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• TDI calculation inputs• Applicable toxicity and exposure parameters	None anticipated
Construction/excavation worker in beach areas	TDI will be estimated from dermal contact and incidental ingestion of sediment. Exposure from inhalation of fugitive dust/vapor will be estimated using EPA inhalation dosimetry methodology. Typical subsurface construction activities such as digging for building foundations are expected to extend approximately 3 feet in depth	Concentrations of chemicals in intertidal surface and subsurface sediment (0-6 feet below mud-line) and surface water.	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• TDI calculation inputs• Applicable toxicity and exposure parameters	None anticipated
Construction/excavation worker in upland site areas ⁵	TDI will be estimated from dermal contact and incidental ingestion of soil. Exposure from inhalation of fugitive dust/vapor will be estimated using EPA inhalation dosimetry methodology.	Concentrations of chemicals in site surface and subsurface soils (0-6 feet below ground surface) and soil vapor (as estimated from soil, groundwater, or vapor data).	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• TDI calculation inputs• Applicable toxicity and exposure parameters	None anticipated

Table 5-3 - Risk Assessment Plan, Baseline Human Health Risk Evaluation

Bremerton Gas Works Superfund Site

Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
On-site occupational worker ⁵	TDI will be estimated from dermal contact and incidental ingestion of soil. Exposure from inhalation of fugitive dust/vapor will be estimated using EPA inhalation dosimetry methodology	Concentrations of chemicals in upland surficial soils (0-3 feet below ground surface) and soil vapor (as estimated from soil, groundwater, or vapor data).	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• TDI calculation inputs• Applicable toxicity and exposure parameters	None anticipated
Future on-site resident ^{5,6}	TDI will be estimated from dermal contact and incidental ingestion of soil. Exposure from inhalation of fugitive dust/vapor will be estimated using EPA inhalation dosimetry methodology. TDI from consumption of groundwater will be considered pending further evaluation of groundwater beneficial uses.	Concentrations of chemicals in upland soils (0-6 feet below ground surface), groundwater, and soil vapor (as estimated from soil, groundwater, or vapor data).	ELCR or health HQ ³	ELCR greater than 1 in 1,000,000 or HQ greater than 1 indicates a chemical of potential concern. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• TDI calculation inputs• Applicable toxicity and exposure parameters	None anticipated

Notes:

1. The risk assessment technical memorandum will present the toxicity data and risk estimation inputs to be used, and will highlight any proposed adjustments to EPA-defined default parameters.

2. The Risk Assessment Technical Memorandum will define supplemental data collection to be used to refine risk estimates. The detailed testing plan will be documented in a Sampling and Quality Assurance Plan amendment.

3. A hazard index will be used to sum HQs for different chemicals with potentially additive effects (i.e., similar toxicological mode of action).

4. Shellfish consumption within Port Washington Narrows is currently subject to harvest restrictions. This evaluation will be performed to evaluate site-related risks associated with future harvesting activities should such restrictions be lifted.

5. No water supply wells are located on or near the Former Gas Works property and is not relevant for the construction worker or occupational worker scenario. Consumption of groundwater will be retained as a potential pathway for screening under the future on-site residential scenario, pending further evaluation of groundwater beneficial uses.

6. The site and vicinity are zoned for industrial uses, and residential use is not applicable to current or reasonably foreseeable uses. However, the risks associated with potential future on-site residential use will be evaluated to understand potential risks, should alternative site uses occur in the future.

BSAF = biota-sediment accumulation factors
ELCR = excess lifetime cancer risk
EPA = U.S. Environmental Protection Agency

HQ = hazard quotient
RI = Remedial Investigation
TDI = Total Daily Intake

Table 5-4 - Risk Assessment Plan, Baseline Terrestrial Ecological Risk Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Avian predator (e.g., robin)	Soil chemical concentrations will be compared to EPA Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of terrestrial bird populations.	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">• Specific data to be used in evaluation• Soil screening levels and/or benchmarks• Applicable exposure parameters	None anticipated
	TDI will be estimated from consumption of soil invertebrates and incidental ingestion of soil. Invertebrate tissue concentrations estimated using soil-to-tissue regression models.			HQ comparing estimated exposures from TDI to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Toxicity reference values• Applicable exposure parameters	None anticipated
Carnivore (e.g., coyote)	Soil chemical concentrations will be compared to EPA Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of terrestrial mammal populations.	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">• Specific data to be used in evaluation• Soil screening levels and/or benchmarks• Applicable exposure parameters	None anticipated
	TDI will be estimated from consumption of soil invertebrates, small mammals and incidental consumption of soil. Tissue concentrations will be estimated using soil-to-tissue regression models.			HQ comparing estimated exposures from TDI to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Toxicity reference values• Applicable exposure parameters	None anticipated
Omnivore (e.g., raccoon)	Soil chemical concentrations will be compared to EPA ecological soil screening levels (Eco SSL) and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of terrestrial mammal populations	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">• Specific data to be used in evaluation• Soil screening levels and/or benchmarks• Applicable exposure parameters	None anticipated
	TDI will be estimated from consumption of plants, invertebrates, and incidental ingestion of soil. Plant and invertebrate tissue concentrations estimated using soil-to-tissue regression models.			HQ comparing estimated exposures from TDI to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Toxicity reference values• Applicable exposure parameters	None anticipated
Herbivore (e.g., vole)	Soil chemical concentrations will be compared to Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of terrestrial mammal populations	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">• Specific data to be used in evaluation• Soil screening levels and/or benchmarks• Applicable exposure parameters	None anticipated
	TDI will be estimated from consumption of plants and incidental ingestion of soil. Plant tissue concentrations estimated using soil-to-tissue regression models.			HQ comparing estimated exposures from TDI to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Toxicity reference values• Applicable exposure parameters	None anticipated

Table 5-4 - Risk Assessment Plan, Baseline Terrestrial Ecological Risk Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Insectivore (e.g., shrew)	Soil chemical concentrations will be compared to Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of terrestrial mammal populations	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">Specific data to be used in evaluationSoil screening levels and/or benchmarksApplicable exposure parameters	None anticipated
	TDI will be estimated from consumption of invertebrates and incidental ingestion of soil. Invertebrate tissue concentrations estimated using soil-to-tissue regression models.			HQ comparing estimated exposures from TDI to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">Specific data to be used in evaluationToxicity reference valuesApplicable exposure parameters	None anticipated
Soil invertebrate	Soil chemical concentrations will be compared to Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction of soil invertebrate communities.	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">Specific data to be used in evaluationSoil screening levels and/or benchmarksApplicable exposure parameters	None anticipated
	Invertebrate tissue concentrations will be estimated using soil-to-tissue regression models.			HQ comparing estimated tissue concentrations to TRV based on no-effects and low-effects concentrations. ³	<ul style="list-style-type: none">Specific data to be used in evaluationToxicity reference valuesApplicable exposure parameters	None anticipated
Upland vegetation	Soil concentrations will be compared to Eco SSL and other relevant interpretative benchmarks (e.g., ORNL soil screening benchmarks).	Evaluation of potential current exposure will use chemical concentrations in upland surface soils (0-6 feet) from vegetated areas including the upland embankment and unpaved upland site areas. Evaluation of potential future exposure will use chemical concentrations in upland surface soils (0-6 feet) cross the site.	Probability of reduced survival, growth, and reproduction plant communities.	HQ comparing upper bound soil concentration to screening levels.	<ul style="list-style-type: none">Specific data to be used in evaluationSoil screening levels and/or benchmarksApplicable exposure parameters	None anticipated

Notes:

1. The risk assessment technical memorandum will present the toxicity data and risk estimation inputs to be used, and will highlight any proposed adjustments to EPA-defined default parameters.
2. If applicable, the Risk Assessment Technical Memorandum will define supplemental data collection to be used to refine risk estimates. If contingent testing is proposed, the detailed testing plan will be documented in a Sampling and Quality Assurance Plan amendment.
3. A hazard index will be used to sum HQs for different chemicals with potentially additive effects (i.e., similar toxicological mode of action).
- Eco SSL = ecological soil screening levels
- HQ = hazard quotient
- ORNL = Oak Ridge National Laboratory

Table 5-5 - Risk Assessment Plan, Baseline Aquatic Ecological Risk Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Piscivorous mammal (e.g., harbor seal)	Dietary TDI will be estimated from consumption of fish and invertebrates.	Concentrations of chemicals in surface sediment (intertidal and subtidal). Bulk sediment data will be used along with applicable BSAFs to estimate chemical concentrations in fish and invertebrate tissue.	Probability of reduced survival, growth, and reproduction of piscivorous mammal populations.	HQ is ratio of TDI to weight-adjusted mammalian TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Exposure parameters• Toxicity reference values	Collection of site-specific tissue samples of prey species may be proposed as an alternative to use of literature-derived BSAFs for estimation of dietary TDI.
Piscivorous raptor (e.g., osprey)	Dietary TDI will be estimated from consumption of fish.	Concentrations of chemicals in surface sediment (intertidal and subtidal). Bulk sediment data will be used along with applicable BSAFs to estimate chemical concentrations in fish tissue.	Probability of reduced survival, growth, and reproduction of aquatic-dependent bird populations.	HQ is ratio of TDI to avian TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Exposure parameters• Toxicity reference values	Collection of site-specific tissue samples of prey species may be proposed as an alternative to use of literature-derived BSAFs for estimation of dietary TDI.
Shore bird (heron)	Dietary TDI will be estimated from consumption of fish, invertebrates, and incidental consumption of intertidal sediment.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and surface water. Bulk sediment data will be used along with applicable BSAFs to estimate chemical concentrations in fish and invertebrate tissue.	Probability of reduced survival, growth, and reproduction of aquatic-dependent bird populations.	HQ is ratio of TDI to avian TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Exposure parameters• Toxicity reference values	Collection of site-specific tissue samples of prey species may be proposed as an alternative to use of literature-derived BSAFs for estimation of dietary TDI.
Shore bird (sandpiper)	Dietary TDI will be estimated from consumption of invertebrates and incidental consumption of intertidal sediment.	Concentrations of chemicals in intertidal surface sediment. Bulk sediment data will be used along with applicable biota-sediment accumulation factors (BSAFs) to estimate chemical concentrations in invertebrate tissue.	Probability of reduced survival, growth, and reproduction of aquatic-dependent bird populations.	HQ is ratio of TDI to avian TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• TDI calculation inputs• Exposure parameters• Toxicity reference values	Collection of site-specific tissue samples of prey species may be proposed as an alternative to use of literature-derived BSAFs for estimation of dietary TDI.
Piscivorous fish (e.g., rockfish)	Surface water chemical concentrations compared directly to AWQC.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and surface water.	Probability of reduced survival, growth, and reproduction of fish populations.	HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">• Specific data to be used in evaluation• AWQC values	None anticipated
	Surface water chemical concentrations evaluated using TU calculations for 34 PAHs.			HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">• Specific data to be used in evaluation• TU calculations	None anticipated
	Fish tissue chemical concentrations will be estimated based on sediment BSAF model compared to tissue-based TRVs.			HQ is ratio of tissue burden to tissue based TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">• Specific data to be used in evaluation• Tissue-specific BSAFs and derivation• Exposure parameters• Toxicity reference values	Collection of site-specific tissue samples may be proposed as an alternative to use of literature-derived BSAFs for this receptor.

Table 5-5 - Risk Assessment Plan, Baseline Aquatic Ecological Risk Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Omnivorous fish (e.g., sculpin)	Surface water chemical concentrations will be compared directly to AWQC.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and surface water.	Probability of reduced survival, growth, and reproduction of fish populations.	HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">Specific data to be used in evaluationAWQC values	None anticipated
	Surface water chemical concentrations will be evaluated using TU calculations for 34 PAHs.			HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">Specific data to be used in evaluationTU calculations	None anticipated
	Fish tissue chemical concentrations will be estimated based on sediment BSAF model compared to tissue-based TRVs.			HQ is ratio of tissue burden to tissue based TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">Specific data to be used in evaluationTissue-specific BSAFs and derivationExposure parametersToxicity reference values	Collection of site-specific tissue samples may be proposed as an alternative to use of literature-derived BSAFs for this receptor.
Benthivorous fish (e.g., flatfish)	Surface water chemical concentrations will be compared directly to AWQC.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and surface water.	Probability of reduced survival, growth, and reproduction of fish populations.	HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">Specific data to be used in evaluationAWQC values	None anticipated
	Surface water chemical concentrations will be evaluated using TU calculations for 34 PAHs.			HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">Specific data to be used in evaluationTU calculations	None anticipated
	Fish tissue chemical concentrations will be estimated based on sediment BSAF model compared to tissue-based TRVs.			HQ is ratio of estimated tissue concentrations and tissue-based TRV based on low- and no-effects concentrations. ³	<ul style="list-style-type: none">Specific data to be used in evaluationBSAFs and derivationExposure parametersToxicity reference values	Collection of site-specific tissue samples may be proposed as an alternative to use of literature-derived BSAFs for this receptor.
Benthivorous shellfish (e.g., crab)	Surface water chemical concentrations will be compared directly to AWQC, including the PAH FCVs.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and surface water.	Probability of reduced survival, growth, and reproduction of shellfish populations.	HQ is the ratio of the concentration in surface water to the protective criteria	<ul style="list-style-type: none">Specific data to be used in evaluationAWQC values	None anticipated
	Surface water chemical concentrations will be evaluated using TU calculations for 34 PAHs.			HQ is the ratio of the concentration in surface water to the protective criteria	<ul style="list-style-type: none">Specific data to be used in evaluationTU calculations	None anticipated
Benthic invertebrates (e.g., benthic infauna community)	Sediment chemical concentrations will be compared to SMS criteria for protection of benthic receptors.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and porewater.	Probability of reduced survival, growth, and reproduction of benthic invertebrate communities.	SMS criteria include the sediment cleanup objective and the cleanup screening level.	<ul style="list-style-type: none">Specific data to be used in evaluationSMS numeric values	Site-specific sediment bioassays may be proposed as an alternative to use of numeric SMS criteria.
	Bulk sediment chemistry and total organic carbon content will be used along with literature-derived equilibrium partitioning coefficients to estimate sediment porewater concentrations for PAH compounds.			Estimated sediment porewater concentrations for 34 PAH compounds will be evaluated using the TU method.	<ul style="list-style-type: none">Specific data to be used in evaluationEquilibrium partitioning coefficientsToxic unit calculations	Site-specific sediment porewater collection and analysis may be proposed as an alternative to use of porewater concentration estimates derived from equilibrium partitioning coefficients.

Table 5-5 - Risk Assessment Plan, Baseline Aquatic Ecological Risk Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Planned Risk Assessment Activities					Parameters to be Refined in Risk Assessment Technical Memo	
Receptor	Estimation Framework(s) for Exposure Pathway	Relevant RI Data to be Used (media and measurements)	Endpoint	Interpretative Framework	Detailed Risk Characterization Parameters ¹	Contingent Testing ²
Macrophytes (e.g., algae and kelp)	Surface water chemical concentrations will be compared directly to AWQC, including the PAH FCVs.	Concentrations of chemicals in surface sediment (intertidal and subtidal) and porewater.	Probability of reduced survival, growth, and reproduction of aquatic plant communities.	HQ is the ratio of the concentration in surface water to the protective criteria.	<ul style="list-style-type: none">Specific data to be used in evaluationAWQC values	None anticipated
	Bulk sediment chemistry and total organic carbon content will be used along with literature-derived equilibrium partitioning coefficients to estimate sediment porewater concentrations for PAH compounds.			Estimated sediment porewater concentrations for 34 PAH compounds will be evaluated using the TU method.	<ul style="list-style-type: none">Specific data to be used in evaluationEquilibrium partitioning coefficientsToxic unit calculations	Site-specific sediment porewater collection and analysis may be proposed as an alternative to use of porewater concentration estimates derived from equilibrium partitioning coefficients.

Notes:

1. The risk assessment technical memorandum will present the toxicity data and risk estimation inputs to be used, and will highlight any proposed adjustments to EPA-defined default parameters.

2. If applicable, the Risk Assessment Technical Memorandum will define supplemental data collection to be used to refine risk estimates. If contingent testing is proposed, the detailed testing plan will be documented in a Sampling and Quality Assurance Plan amendment.

3. A hazard index will be used to sum HQs for different chemicals with potentially additive effects (i.e., similar toxicological mode of action).

AWQC = ambient water quality criteria
BSAF = biota-sediment accumulation factors
FCV = final chronic value
HQ = hazard quotient
PAH = polycyclic aromatic hydrocarbon

Table 5-6 – Data Quality Objectives Contamination in Soil and Groundwater

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary determine the lateral and vertical extent of contamination in soil and groundwater, and evaluate risks to human and ecological receptors.
Identify the Goal of the Study	<p>The goals are to:</p> <ul style="list-style-type: none"> • Determine the nature and extent of contaminant concentrations in soil and groundwater exceeding PRGs at the Site. • Determine seasonal variability in contaminant concentrations in groundwater. • Obtain adequate and representative data from soil and groundwater for use in the Baseline Human Health and Ecological Risk Assessments. • Determine the potential for recontamination of the Site from groundwater flowing from adjacent sites.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> • Preliminary conceptual site model (CSM) (see Section 4.0). • ARARs, RAOs, and PRGs (see Section 3.1). • Concentrations of COPCs, including VOC, SVOC, pesticide, PCB, cyanide, dioxin/furan, and metals, in soil. • Concentrations of COPCs in groundwater. • Site geology and hydrogeology, including groundwater occurrence and flow characteristics.
Define the Boundaries of the Study	<p>Spatial boundaries: The horizontal extent of the study area is defined by the upland portion of the ISA. The vertical extent of the study area will be based on bounding contamination (as determined by comparison of analytical data to PRGs) during the course of the study. Based on data collected during the study, the boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located.</p> <p>Temporal boundaries: Data of sufficient quality (see Section 3.6.2) from previous investigations (beginning in 2007) to those collected as part of this study will be used.</p> <p>Constraints on data collection: The field work and evaluation of data will be phased in order to allow for refinement to the scopes of work for subsequent RI activities. Other constraints may include limitations due to sampling methods, drilling refusal, encountering subsurface structures (such as piping or foundations), or issues with sampling adjacent properties.</p>

Table 5-6 – Data Quality Objectives Contamination in Soil and Groundwater

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
Develop the Analytic Approach	<p>Nature and extent of contamination: Analyte concentrations from soil and groundwater samples will be used to determine the study boundaries (defined as the extent of contamination). Sample-specific concentrations will be compared to PRGs (see Section 3.1.3). Data will be evaluated and displayed using figures and tables, and the findings will be used to update the CSM.</p> <p>Risk assessment: Soil and groundwater data will be used to estimate exposure-point concentrations for use in estimating risks based on exposure to soil and groundwater (details will be developed and documented in the Risk Assessment Technical Memorandum).</p>
Specify Performance or Acceptance Criteria	<p>Ensure, through data review and validation, that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix A, Upland SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate delineation of contaminant nature and extent, and estimates of exposure for the risk assessment, and subsequent identification of areas and media requiring remediation.</p>
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Upland SQAPP (Appendix A). A stepwise approach is proposed to determine the extent of contamination in soil and groundwater:</p> <ul style="list-style-type: none"> Investigate and identify potential sources through geophysical surveys Investigate potential sources via trenches, test pits, and borings at locations of historical Site features and subsurface anomalies identified by the geophysical surveys. Delineate sources based on field observations. Collect samples of source materials to evaluate the types of contaminants associated with each. Collect samples of soil beneath potential sources to evaluate vertical extent of contaminants. Analyze samples for all COPCs. Characterize soil immediately downgradient of source areas with deep borings, collecting samples of fill, vadose zone, shallow water table, deep water table/aquitard, and lower aquifer soils if present. Analyze samples for all COPCs. Determine depths and locations of wells in and downgradient of Source Areas based on soil data, install wells, and characterize groundwater. Evaluate contaminant concentrations in soil outside source areas using incremental sampling methodology (ISM) to a depth of 6 feet. Install monitoring wells outside source areas and analyze groundwater for all COPCs to determine the extent of contamination above PRGs. Conduct quarterly monitoring of contaminants in groundwater at monitoring wells for a minimum of 1 year to assess seasonal variability.

Table 5-7 – Data Quality Objectives Sources of Contamination (Upland)

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to identify the location of historical sources of contamination at the Site.
Identify the Goal of the Study	<p>The goals are to:</p> <ul style="list-style-type: none"> Determine locations where contaminants may have been released for the purposes of targeting subsurface investigations. Evaluate the potential presence of subsurface features that may act as a source or conduit of contamination. Delineate the source boundaries and/or estimate the source dimensions. Identify the types of contaminants associated with each source.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Preliminary conceptual site model (CSM) (see Section 4.0). Contaminant concentrations in soil, groundwater, and source materials (e.g., NAPL). Site geology including fill composition and occurrence. Historical information, including aerial photographs. Utility and geophysical surveys. Subsurface survey through observation of targeted, shallow excavations (borings, test pits, and trenches).
Define the Boundaries of the Study	<p>Spatial Boundaries: The horizontal extent of the study area is defined by the extent of historical gas works operations, including the fill areas in the former ravine and along the shoreline. The vertical extent of the study area will be based on bounding the depths of sources, including the depth of fill, during the course of the study as feasible for the exploration tools used.</p> <p>Constraints on data collection: The field work and evaluation of data will be phased in order to allow for evaluation of initial data to inform subsequent RI activities. Other constraints may include limitations due to drilling refusal, stability of trenches/test pits; encountering subsurface features that affect survey equipment response; or access issues with sampling adjacent properties.</p>
Develop the Analytic Approach	Collected information, survey data, and observations will be used to identify areas for further exploration and sampling. Analyte concentrations in source materials will be used to evaluate source composition. Data will be evaluated and displayed using figures and tables, and the findings will be used to update the CSM.
Specify Performance or Acceptance Criteria	<p>Geophysical surveys are a qualitative evaluation.</p> <p>For analytical sampling of sources: Ensure through data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix A, Upland SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate characterization of different potential sources.</p>

Table 5-7

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Table 5-7 – Data Quality Objectives Sources of Contamination (Upland)

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Upland SQAPP (Appendix A). A stepwise approach is proposed to identify potential sources:</p> <ul style="list-style-type: none">• Utility/geophysical surveys will be used to update Site maps of potential sources and target explorations.• Historical and survey data will be used to locate explorations (borings, test pits, or trenches).• The lateral and vertical extent of sources will be determined based on field observations.• Representative samples of source materials will be collected from shallow excavations for chemical analysis.• Alignment of buried pipes, if encountered, will be further located as practicable using utility location techniques.

Table 5-8 – Data Quality Objectives Site Physical Characteristics

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to characterize Site physical characteristics.
Identify the Goal of the Study	<p>The goals are to:</p> <ul style="list-style-type: none"> • Determine soil lithology and physical properties of lithologic units. • Determine hydraulic characteristics of Site aquifer units. • Understand role of tidally-influenced surface water on groundwater flow. • Evaluate whether Site groundwater is a potential drinking water source.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> • Preliminary conceptual site model (CSM) (see Section 4.0). • Logging of Site soil lithology from subsurface explorations. • Physical soil characteristics, including gradation, density, Atterberg limits, penetration tests, and moisture content. • Hydraulic conductivity of aquifer units. • Water levels at Site wells throughout seasonal and tidal cycles. • Salinity data at Site monitoring wells.
Define the Boundaries of the Study	The study area is defined by the upland portion of the ISA. The horizontal boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located. The vertical extent of the study area will extend to include lithologic and aquifer units to define the vertical extent of contaminants in soil and groundwater at concentrations exceeding the PRGs.
Develop the Analytic Approach	Identify distinct lithologic and aquifer units through soil sampling. Submit representative samples from each unit for physical testing (Appendix A). Conduct hydraulic testing of aquifer units at representative monitoring wells (Appendix A).
Specify Performance or Acceptance Criteria	Physical data will be collected and analyzed using standard test measurements and procedures. Soil lithology characterization and sampling will be performed under the supervision of a registered geologist. Hydraulic testing will be performed under the supervision of a registered hydrogeologist.
Develop the Plan for Obtaining Data	The detailed plan for obtaining data is presented in this work plan and accompanying Upland SQAPP (Appendix A). All subsurface explorations at the Site will be logged, and representative samples from each distinct lithologic unit will be analyzed for physical parameters. An initial study of tidally influenced groundwater flow will be conducted using water-table wells, and a limited number of deeper wells, to develop a preliminary estimate of groundwater flow characteristics and assist in locating subsequent explorations. A subsequent tidal study and hydraulic testing will be performed for contaminated aquifer units after the vertical and lateral limits of contaminated groundwater are determined.

Table 5-8

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Table 5-9 – Data Quality Objectives

NAPL Characterization

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is required to characterize the extent of NAPLs, their physical and chemical characteristics, and their potential mobility.
Identify the Goal of the Study	<p>The goals are to:</p> <ul style="list-style-type: none"> • Determine the lateral and vertical boundaries of NAPL occurrences. • Characterize soil characteristics surrounding NAPL occurrences. • Identify physical and chemical characteristics of NAPL. • Evaluate NAPL mobility.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> • Preliminary conceptual site model (CSM) (see Section 4.0). • Logging of Site soil lithology from subsurface explorations. • Field observations of potential NAPL indicators. • Chemical concentrations of contaminants in soil samples where NAPL may be observed. • Measurements of NAPL presence and thickness in monitoring wells. • Analysis of NAPL samples for physical properties, including viscosity, density, and flash point, and chemical composition.
Define the Boundaries of the Study	<p>The study area is defined by the upland portion of the ISA. The boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located. The vertical extent of the study area will extend to include geologic units to the maximum depth of NAPL extent.</p> <p>Constraints on data collection: The field work and evaluation of data will be phased in order to allow for evaluation of initial data to inform subsequent RI activities. Limitations may include depth limitations on exploration techniques (refusal during drilling or test pit/trench stability), subsurface obstructions such as utilities, surface obstructions such as buildings, and access issues on adjacent properties. Different tools (auger or sonic drilling) may be utilized, as needed, to achieve required depths.</p>
Develop the Analytic Approach	<p>Assess subsurface soil during logging for the potential presence of NAPL and to characterize soil lithology around potential NAPL occurrences. Where potential NAPL is observed, collect samples of potential NAPL-impacted soil for chemical analysis. Install monitoring wells at locations of potential NAPL occurrence and gauge for NAPL presence and thickness.</p> <p>Where measurable NAPL is observed in monitoring wells, collect NAPL samples for laboratory analysis.</p> <p>Where NAPL is observed in the subsurface, contingent studies for characterizing the lateral and vertical extent of NAPL include the TarGOST technology (see Section 5.6).</p> <p>Where sufficient NAPL is measured in monitoring wells, contingent studies for characterizing mobility and recoverability of NAPL include baildown testing at representative wells containing NAPL (see Section 5.6).</p>

Table 5-9

Table 5-9 – Data Quality Objectives

NAPL Characterization

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
Specify Performance or Acceptance Criteria	Physical and chemical testing of NAPL samples to be conducted following EPA-approved and/or standard test methods. Soil logging to be performed under the supervision of a registered geologist.
Develop the Plan for Obtaining Data	The detailed plan for obtaining data is presented in this work plan and accompanying Upland SQAPP (Appendix A). NAPL investigations will work from the known to the unknown, starting with suspected source areas and extending outward from identified sources until the lateral and vertical extent of NAPL is identified.

Table 5-10 – Data Quality Objectives

Contaminant Fate and Transport

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to characterize contaminant transport and attenuation at the Site.
Identify the Goal of the Study	<p>The goals are to:</p> <ul style="list-style-type: none"> Evaluate contaminant transport within and partitioning between environmental media. Evaluate potential mechanisms for contaminant attenuation.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Logging of Site soil lithology from subsurface explorations. Total organic carbon in soil and sediment. Chemical concentrations of contaminants in soil, groundwater, sediment, and surface water. Conventional geochemical parameters in groundwater, including sodium, calcium, potassium, magnesium, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, ferrous and ferric iron, dissolved manganese, organic carbon, dissolved oxygen, pH, and temperature.
Define the Boundaries of the Study	The study area is defined by the ISA. The boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located.
Develop the Analytic Approach	<p>Assess subsurface soil lithology to evaluate potential preferential migration pathways. Collect and analyze representative samples of each lithologic unit for total organic carbon for evaluations of leaching and sorption.</p> <p>Qualitatively evaluate geochemical parameters, in conjunction with contaminant data, to assess potential for ongoing natural attenuation of contaminants.</p> <p>Conduct vapor intrusion modeling to assess potential contaminant concentrations in indoor air, if structures were present. If the extent of contamination and modeling results indicate a potential exposure risk, soil vapor and/or indoor air sampling may be conducted. See Section 5.6, contingency studies.</p>
Specify Performance or Acceptance Criteria	Ensure thorough data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols.
Develop the Plan for Obtaining Data	The detailed plan for obtaining data is presented in this work plan and accompanying Upland SQAPP (Appendix A). Lithologic characterization and collection of samples for total organic carbon analysis will be performed during soil and sediment investigations. Geochemical monitoring will be included in groundwater monitoring program.

Table 5-11 – Data Quality Objectives—Habitat and Intertidal Shellfish Surveys

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to define intertidal and subtidal baseline habitat conditions within Port Washington Narrows. The information will not be used for risk determination or consumption rates.
Identify the Goals of the Study	<ul style="list-style-type: none"> Evaluate intertidal and subtidal habitat characteristics within the Site and vicinity, including differences in sediment grain size, vegetation, epifauna, other fish and wildlife and physical features (e.g., bed rock outcropping or anthropogenic features). Quantify the existing abundance of shellfish resources in beach areas of the initial study area (ISA) to establish baseline conditions.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Visual surveys of intertidal and subtidal habitat characteristics within the Site and vicinity, are needed to identify structures and differences in sediment grain size, vegetation, epifauna, and identify habitat for other fish and wildlife. Direct baseline assessment of the abundance of current shellfish in beach areas in within and the immediate vicinity of the Initial Study Area (ISA).
Define the Boundaries of the Study	<ul style="list-style-type: none"> Visual surveys of intertidal and subtidal habitat characteristics will extend throughout the ISA, including transects located in parallel and perpendicular to the axis of the narrows and located along different depth profiles. Baseline assessment to be conducted within and the immediate vicinity of the ISA.
Develop the Analytic Approach	<ul style="list-style-type: none"> Visual surveys will be performed using a towed camera with integrated DGPS position logging so that all visual observations may be georeferenced. The baseline shellfish assessment will be performed using methods developed by the Washington Department of Fish and Wildlife for this purpose (Appendix B).
Specify Performance or Acceptance Criteria	<ul style="list-style-type: none"> The DGPS position logging will be verified during the visual surveys to confirm the accuracy of survey locating. The visual quality of the survey will be monitored during collection with a real-time video feed to verify the usability of collected footage. Surveys of current shellfish resources will comply with quality assurance/quality control protocols developed by the Washington Department of Fish and Wildlife. Baseline assessment results will not be used to inform risk assessment.
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Marine Sampling and Quality Assurance Project Plan (SQAPP; Appendix B).</p> <ul style="list-style-type: none"> Visual surveys will be conducted by towed camera surveys with position logging and real-time video feed for confirming data acquisition. Planned survey transects are defined in the SQAPP. Shellfish surveys will be conducted during low-tide events following applicable WDFW methodologies. The planned sampling locations are defined in the SQAPP.

Table 5-12

Data Quality Objectives—Contamination in Surface Sediment

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to determine the lateral extent of contamination in intertidal and subtidal surface sediment (0–4-inch depth interval). Based on data collected during the study, the boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located. The data will also provide the information necessary to support the evaluation of risks to human health and ecological receptors exposed to surface sediment.
Identify the Goals of the Study	<ul style="list-style-type: none"> Determine the nature and extent of contaminant concentrations in surface sediment, exceeding PRGs at the Site. Obtain adequate and representative data from surface sediment for use in the Baseline Human Health and Ecological Risk Assessment Evaluate Site-specific polycyclic aromatic hydrocarbon (PAH) bioavailability in sediment porewater relative to literature-derived partitioning coefficients.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Initial sampling in potential source areas for comprehensive physical and chemical testing to identify preliminary contaminants of potential concern and characterize the lateral extent of contamination in surface sediments. This data inputs will also be used to inform the risk assessment process. Sampling for comprehensive physical and chemical parameters in intertidal and subtidal surface sediment within the ISA. Paired sampling of PAHs in bulk sediment and porewater at selected locations to evaluate partitioning.
Define the Boundaries of the Study	<p>Chemical testing of surface sediments will be conducted within the Initial Study Area. However, based on data collected during the study, the boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located.</p> <p>Temporal boundaries: Data of sufficient quality (see Section 3.6.2) from previous sediment investigations (beginning in 2010) to those collected as part of this study will be used, if necessary to delineate the study boundary</p> <p>Constraints on data collection: The field work and evaluation of data will be phased in order to allow for evaluation of initial data to inform subsequent RI activities. Other limitations may result from sampling methodology such as refusal.</p>
Develop the Analytic Approach	<p>Nature & Extent of Contamination: Chemical testing results from sediment samples will be used to determine the study boundaries (defined as the extent of contamination). Sample-specific concentrations will be compared to PRGs (see Section 3.1.2). Data will be evaluated and displayed using figures and tables, and the findings will be used to update the CSM.</p> <p>Risk Assessment: Sediment data will be used to estimate exposure point concentrations for use in estimating risks as part of the risk assessment technical memo). Porewater PAH concentrations will also be evaluated using the EPA (2003) equilibrium partitioning sediment benchmark framework.</p>

Table 5-12

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Table 5-12**Data Quality Objectives—Contamination in Surface Sediment**

Bremerton Gas Works Superfund Site

Bremerton, Washington

Step	Description
Specify Performance or Acceptance Criteria	<p>Ensure thorough data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix B, Marine SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate delineation of contaminant nature and extent and estimates of exposure for the risk assessment, and subsequent identification of areas and media requiring remediation.</p>
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Marine SQAPP.</p> <ul style="list-style-type: none">• Initial sampling locations were identified during RI/FS scoping and discussions with the EPA project team based on historical source areas, previous sampling results, and an analysis of potential sediment fate and transport processes. This sampling plan is identified in the SQAPP.• The Administrative Order on Consent (AOC) and RI/FS Work Plan include contingencies for additional sampling, should the nature and extent of Site-related contamination not be fully delineated during the initial sampling effort.

Table 5-12

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Table 5-13
Data Quality Objectives—Contamination in Subsurface Sediment
 Bremerton Gas Works Superfund Site
 Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to determine the lateral and vertical extent of contamination in intertidal and subtidal subsurface sediment (greater than 4-inch depth interval) Define the Boundaries” step: “Based on data collected during the study, the boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located and to provide information necessary to support the evaluation of human health risks for exposures to subsurface sediment in intertidal areas.
Identify the Goals of the Study	<ul style="list-style-type: none"> Determine the nature and extent of contaminant concentrations in subsurface sediment exceeding applicable PRGs. Obtain adequate and representative data from surface sediment for use in the Baseline Human Health and Ecological Risk Assessment.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Document sediment stratigraphy at each coring location, including screening for potential presence of NAPL, hydrocarbon contamination or other anthropogenic impacts. Quantify concentrations of a comprehensive suite of chemicals in subsurface sediments from a minimum of two subsurface depth intervals, representing the zone of highest apparent contamination and the top of the uncontaminated sediment layer. Analysis of additional archived sediment samples may be required depending on the results of initial sample analysis. Confirm sediment stratigraphy with selected analysis of sediment grain size.
Define the Boundaries of the Study	<p>Spatial boundaries: The vertical extent of the study area is defined by contaminants in the subsurface sediments (as determined by comparison of analytical data to PRGs) during the course of the study. Based on data collected during the study, the vertical boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located.</p> <p>Temporal boundaries: Data of sufficient quality (see Section 3.6.2) from previous sediment subsurface investigations (beginning in 2013) to those collected as part of this study will be used.</p> <p>Constraints on data collection: The field work and evaluation of data will be phased in order to allow for evaluation of initial data to inform subsequent RI activities Other limitations may result from sampling methodology such as refusal.</p>
Develop the Analytic Approach	Vertical Nature & Extent of Contamination: Chemical testing results from subsurface sediment samples will be used to determine the vertical extent of contamination. Sample-specific concentrations will be compared to PRGs (see Section 3.1.2). Data will be evaluated and displayed using figures and tables, and the findings will be used to update the CSM.
Specify Performance or Acceptance Criteria	<p>Ensure thorough data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix B, Marine SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate delineation of contaminant nature and extent and subsequent identification of areas and media requiring remediation.</p>

Table 5-13
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Table 5-13
Data Quality Objectives—Contamination in Subsurface Sediment
 Bremerton Gas Works Superfund Site
 Bremerton, Washington

Step	Description
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Marine SQAPP.</p> <ul style="list-style-type: none"> Initial sampling locations were identified during RI/FS scoping and discussions with the EPA project team based on historical source areas, previous sampling results, and an analysis of potential sediment fate and transport processes. This sampling plan is identified in the SQAPP. The Administrative Order on Consent (AOC) and RI/FS Work Plan include contingencies for additional sampling, should the nature and extent of Site-related contamination not be fully delineated during the initial sampling effort.

Table 5-14

Data Quality Objectives—Contamination in Surface Water

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to determine the nature and extent of Site-related contaminants surface water and to support the evaluation of human health and ecological risks.
Identify the Goals of the Study	<ul style="list-style-type: none"> Determine the nature and extent of confirmed contaminant concentrations in surface water at the Site. Obtain adequate and representative data from surface sediment for use in the Baseline Human Health and Ecological Risk Assessment.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Measurement of a comprehensive suite of chemicals in surface water at locations within the ISA and at background stations within Port Washington Narrows. Parallel testing for conventional parameters, including total organic carbon, dissolved organic carbon, total suspended solids, dissolved oxygen, pH, salinity, and temperature.
Define the Boundaries of the Study	<p>Spatial boundaries: The extent of the study area is defined by Site-related comprehensive chemical testing in the surface water (as determined by comparison of ISA results background station and applicable water quality criteria) during the course of the study. Based on data collected during the study, the boundaries of the study area will be adjusted as needed to encompass the extent of where contamination from the Site has come to be located.</p>
Develop the Analytic Approach	<p>Nature & Extent of Contamination: Chemical testing results will be used to determine the extent of contamination in surface water. Sample-specific concentrations will be compared to background stations and applicable water quality criteria. Data will be evaluated and displayed using figures and tables, and the findings will be used to update the CSM.</p> <p>Temporal boundaries: Data will be collected during in the dry and wet seasons to determine any temporal trends in surface water quality.</p>
Specify Performance or Acceptance Criteria	<p>Ensure thorough data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix B, Marine SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate delineation of contaminant nature and extent and estimates of exposure for the risk assessment, and subsequent identification of areas and media requiring remediation.</p>
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Marine SQAPP.</p> <ul style="list-style-type: none"> Surface water sampling locations include two areas within the ISA that could potentially be impacted by releases from groundwater or sediment. Two background locations within Port Washington Narrows are included to help differentiate potential Site-related impacts and contamination from off-Site sources. Four rounds of sampling are included to assess the potential seasonal variability in surface water contaminant concentrations.

Table 5-14

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Table 5-15 - Data Quality Objectives—Marine Area Current and Sediment Transport Processes

Bremerton Gas Works Superfund Site
Bremerton, Washington

Step	Description
State the Problem	Additional information is necessary to support sediment transport evaluations, including littoral drift and bed load.
Identify the Goals of the Study	<ul style="list-style-type: none"> Quantify near-bottom tidal currents within Port Washington Narrows for use, along with sediment grain size distribution quantified in other RI activities, in evaluating the stability of the existing bed sediments within the ISA. Quantify the physical characteristics of surface sediments in adjacent areas of Port Washington Narrows to support the FS evaluation of assess sediment movement and deposition within the Port Washington Narrows.
Identify Information Inputs	<p>Information inputs include:</p> <ul style="list-style-type: none"> Measurements of the direction and velocity of tidal currents in mid depth and near-bottom areas of Port Washington Narrows during relatively strong and approximately average ingoing and outgoing tides. Measurements of the physical parameters of surface sediments in off-Site areas of Port Washington Narrows. Modeled wind and wave action to supplement measured tidal current data
Define the Boundaries of the Study	<ul style="list-style-type: none"> The boundary for the tidal current study includes four transects extending south to north across Port Washington Narrows extending from the Former Gas Works and adjacent beach areas out beyond the boundaries of the ISA . The boundary for the study of surface sediment physical characteristics within Port Washington Narrows extends from the ISA east and west to the ends of Port Washington Narrows.
Develop the Analytic Approach	<ul style="list-style-type: none"> Tidal currents will be measured using a vessel-mounted Acoustic Doppler Current Profiler in order to document changes in tidal currents with depth, location, and time during the course of a daily tide cycle with strong ingoing and outgoing tides. Physical measurements (total organic carbon, total solids, and grain size) of intertidal and subtidal surface sediments of Port Washington Narrows will be quantified using EPA-approved methods. Portions of these samples will be archived for potential chemical analysis, if necessary, to inform recontamination potential when coupled with sediment transport evaluation results.
Specify Performance or Acceptance Criteria	<p>Ensure thorough data review and validation that the analytical data for collected samples are within acceptable quality limits as defined by applicable EPA data quality protocols (Appendix B, Marine SQAPP).</p> <p>Ensure that sampling and analytical representativeness allow for adequate characterization sediment physical characteristics within the Port Washington Narrows.</p>

Table 5-15 - Data Quality Objectives—Marine Area Current and Sediment Transport Processes

Bremerton Gas Works Superfund Site

Bremerton, Washington

Step	Description
Develop the Plan for Obtaining Data	<p>The detailed plan for obtaining data is presented in this work plan and accompanying Marine SQAPP.</p> <ul style="list-style-type: none">• Tidal surveys will be conducted by a qualified contractor along transects at the specified locations during a tidal cycle with strong ingoing and outgoing tides.• Sediment sampling locations were selected to include both areas subject to potential sediment movement by littoral drift and sediments subject to potential current-induced sediment movement.• In order to allow for possible use of archived sediment to evaluate recontamination potential, sampling locations were adjusted to avoid areas likely to be impacted by known or suspected pollution sources

Table 5-16 Summary of Marine Sampling Design

Bremerton Gas Works Superfund Site
Bremerton, Washington

Area	Sub-Area	Sample Type	Purposes	Number of Samples and Location Rationale	Primary Testing Parameters
Sediment Sampling					
Initial Study Area	Collocated Intertidal and Subtidal Sediment Grabs and Cores	Intertidal Grab Samples	To define the horizontal nature and extent of contamination in intertidal sediments	Bulk chemistry at five intertidal stations collected throughout beach area adjacent to former Gas Works and ravine	Site COPCs ^a and alkylated PAHs
			Evaluate concentrations of Site COPCs along Gas Works intertidal area	Supplemental testing for bulk chemistry at five intertidal stations adjacent to former Gas Works and ravine	
			Evaluate porewater concentrations of PAH and alkylated PAH concentrations	Porewater chemistry at five intertidal stations	PAHs (including alkylated) in porewater
		Subtidal Grab Samples	To define the horizontal nature and extent of contamination in subtidal sediments	Twelve subtidal stations collected in transects down the slope toward to the channel elevation.	Site COPCs ^a and alkylated PAHs
				Two subtidal stations collected in the westernmost transect and located within the marina	
	Vibracores	To define the vertical nature and extent of contamination in intertidal and subtidal sediments in including NAPL and sheens	Five intertidal and fourteen subtidal stations Advanced in transects down the slope toward to the channel elevation and two within the marina	Site COPCs ^a	
	Other Intertidal and Subtidal Sediment Grabs	Intertidal Grab Samples	Provide bounding to the nature and extent of site-associated impacts in intertidal sediment	Two stations Step-out sampling in accessible intertidal areas within eastern extent of the ISA; the western intertidal extent is a riprap armored slope and not generally accessible	Site COPCs ^a and alkylated PAHs
Subtidal Grabs		To define the horizontal nature and extent of contamination in subtidal sediments	Fourteen stations Step-out sampling between slope area and ISA boundary		
Port Washington Narrows	Intertidal	Surface Grab	Document physical characteristics of intertidal sediments within Port Washington Narrows to inform sediment transport evaluations including littoral drift and bed load (to be evaluated with ADCP)	Eleven stations Collection of six along north side and five along the south side of the Port Washington Narrows stations placed in publicly accessible intertidal areas	TS, TOC, grain size, archive ^b
	Subtidal (Channel Bottom)			Five stations Collection along the general centerline and deeper sections of the channel	
Surface Water Sampling					
Initial Study Area	Surface Water	Grab	Quantify concentrations of Site COPCs in surface water	Two locations Seasonal sampling at two depths per location	Site COPCs ^c and alkylated PAHs
Port Washington Narrows		Grab	Quantify concentrations of Site COPCs in surface water to assess potential regional influences	Two locations Seasonal sampling at two depths per location	
Habitat and Physical Surveys					
Initial Study Area and Port Washington Narrows	Subtidal	Towed-Camera Survey	Refine environmental setting information	Six transects perpendicular to and five transects in parallel with the Port Washington Narrows	Mapping of substrate, vegetation, aquatic species, and structures
	Subtidal	ADCP Transects	Measure near-bottom currents that may impact sediment stability	Four transects perpendicular to Port Washington Narrows (two tide conditions)	Conduct empirical measurements of near-bottom and mid-channel tidal currents for use in an analysis of sediment stability
Initial study area	Intertidal	Visual and Photo Survey	Conduct surveys of aquatic habitat and fish/shellfish resources near the Site	Seven locations within/adjacent to ISA intertidal area	Visual survey of shellfish resources

Notes:

a. Cyanide, WAD cyanide sulfide, grain size, hexavalent chromium, metals, organochlorine pesticides, PAHs, PCB Aroclors, SVOCs, TOC. Tiered analysis for PCB congeners, VOCs, and PCDD/PCDF will be contingent upon screening parameters (Sections 3.1.3 and 3.1.5).

b. Samples will be archived frozen for contingent analysis should additional testing be required.

c. Cyanide, WAD cyanide sulfide, DOC, grain size, hexavalent chromium, metals, organochlorine pesticides, PAHs, PCB Aroclors, SVOCs, TOC, TSS, VOCs.

ADCP - acoustic doppler current profiler

NAPL - non-aqueous phase liquid

TBD - to be determined

COPCs - chemicals of potential concern

PAH - polynuclear aromatic hydrocarbons

TOC - total organic carbon

D/F - dioxine/furan

PCB - polychlorinated biphenyl

TS - total solids

ISA - initial study area

SVOC - semi-volatile organic compound

WAD - weak acid dissociable

Table 7-1 - Remedial Technologies for NAPL

Bremerton Gas Works Superfund Site
Bremerton, Washington

NAPL General Response Actions	Remedial Technology	Process Options	Description
Institutional Controls ¹	Access Restrictions	Fences and warning signs to control Site access	Signs, fences, or other measures to prevent access to the Site.
	Use Restrictions	Use restrictions and monitoring to prevent disturbance of engineered controls	Covenant placed on property that limits or prohibits activities that may interfere with a cleanup action or result in exposure to hazardous substances. Use and deed restrictions are often used in conjunction with other technology approaches.
		Deed restrictions addressing soil disturbance and/or groundwater wells	
<i>In-Situ</i> Containment	Vertical Barriers	Slurry Wall	Control lateral movement of NAPL by excavating a trench and backfilling with a low-permeability material (e.g., bentonite slurry), or <i>in situ</i> mixing of bentonite with native soils.
		Sheet Pile Wall	Control lateral movement of NAPL by installing (driving or vibrating) steel or plastic sheet piling.
		Grout Curtain	Control lateral movement of NAPL by pressure injecting hydraulic cements, clays, bentonite, and silicates into the formation through tightly spaced borings using jetting tools.
<i>In-Situ</i> Treatment	Low-Temperature Thermal Treatment	Hot Water Injection	A variety of heating methods, heating to temperatures less the boiling point of water, increasing the mobility and solubility of NAPL. Contaminated liquids, including NAPL, are removed by pumping from wells, and contaminants are treated. Heating can be performed by injecting hot water in vertical wells, thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Electrical Resistance Heating	
		Thermal Conductive Heating	
	Mid-Temperature Thermal Treatment	Steam Injection	The subsurface is heated to temperatures near the boiling point of water, volatilizing or destroying (by pyrolysis) volatile organic compounds. Contaminated vapors are collected using soil vapor extraction, contaminated liquids are removed by pumping from wells, and contaminants are treated. Heating can be performed by injecting steam in vertical wells, thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Electrical Resistance Heating	
		Thermal Conductive Heating	
	High-Temperature Thermal Treatment	Electrical Resistance Heating	The subsurface is heated to temperatures above the boiling point of water, volatilizing or destroying (by pyrolysis) volatile and semi-volatile organic compounds. Contaminated vapors are collected using soil vapor extraction, contaminated liquids are removed by pumping from wells, and contaminants are treated. Heating can be performed by thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Thermal Conductive Heating	
	Stabilization	Solidification/Stabilization	Soil containing NAPL is stabilized by adding amendments to solidify or immobilize contaminants. Potential amendments include polymers, pozzolans, and cement. Amendments can be mixed with soil <i>in situ</i> using large-diameter augers, soil mixers, or similar equipment.
Removal	Chemical Treatment	Chemical oxidation	Chemical oxidation involves the injection of chemical oxidants into the subsurface to react with and destroy organic contaminants. Common oxidants include hydrogen peroxide, potassium permanganate, ozone, and sodium persulfate.
	NAPL Pumping	Pumping of NAPL from wells and trenches	Pumping to remove NAPL that accumulates in a well or trench.
	Surfactant Enhanced Recovery	Pumping of mobilized NAPL	Surfactants are injected near NAPL zones in groundwater to mobilize the NAPL, and then the mobilized NAPL is extracted. May be applied with injection-withdrawal technique or with recirculating system.
<i>Ex-Situ</i> Treatment	Thermal	Excavation	NAPL is removed by excavating soil containing NAPL.
		Co-Burning	Combustion of coal tar- or tar-contaminated soil with coal in utility boilers and cement kilns.
		Incineration	When soil or sediment containing NAPL is heated to temperatures above 1,400°F, contaminants are directly oxidized.
Disposal	Off-Site Management	Recycling of recovered NAPL	Reuse of recovered product.
		Disposal of recovered NAPL via incineration	Treatment of NAPL via incineration at a hazardous waste treatment facility.

Notes:
¹Institutional controls are not considered stand-alone remedial technologies but may be applied in conjunction with other cleanup technologies.
BTEX = benzene, toluene, ethylbenzene, and xylenes
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
NAPL = non-aqueous phase liquid
O&M = operation and maintenance
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons

Table 7-2 - Remedial Technologies for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Soil General Response Actions	Remedial Technology	Process Options	Description
Institutional Controls ¹	Access Restrictions	Fences and warning signs to control Site access	Signs, fences, or other measures to prevent access to the property.
	Use Restrictions	Use restrictions and monitoring to prevent disturbance of engineered controls	Covenant placed on the property that limits or prohibits activities that may interfere with a cleanup action or result in exposure to hazardous substances.
		Deed restrictions addressing soil disturbance	
In-Situ Containment	Capping	Permeable soil cover	Placing clean soil on the surface provides a barrier that prevents exposure to underlying soil but allows storm water to infiltrate.
		Low-permeability cap	Low-permeability caps may be constructed of low-permeability soil such as clay or an engineered material such as asphalt or concrete. This cap would not only prevent exposure to underlying soils, but would also minimize stormwater infiltration through potentially contaminated materials, thereby reducing mobility of contaminants located in the unsaturated soil zone. Engineered materials could also be used in areas requiring a durable surface, such as high-traffic areas.
		Impervious cap	Impervious caps may be constructed of low-permeability soil such as clay or an engineered material such as asphalt or concrete, overlain by an additional impermeable layer. This cap would not only prevent exposure to underlying soils, but would also prevent stormwater from infiltrating through potentially contaminated soils beneath the cap, thereby reducing mobility of contaminants located in the unsaturated soil zone. Often combined with barrier wall technology to fully encapsulate soils.
In-Situ Treatment	Physical Removal and Treatment	Passive venting of soil vapors	Passive soil venting is a less aggressive version of soil vapor extraction that is usually applied to prevent contaminated soil vapors from migrating into buildings or crawl spaces. In passive venting, soil vapors beneath a building foundation are vented to the atmosphere either through atmospheric pressure changes or by applying a low vacuum with a ventilation fan. Vented vapors can be passed through activated carbon for treatment if necessary.
		Soil vapor extraction	Soil vapor extraction applies a vacuum to subsurface soil to volatilize contamination and extract soil vapor. Vapor stream is treated above ground to remove contamination before discharge.
	Low-Temperature Thermal Treatment	Hot Water Injection	The subsurface is heated to temperatures less than the boiling point of water, increasing the mobility and solubility of NAPL and NAPL constituents. Contaminated liquids are removed by pumping from wells, and contaminants are treated. Heating can be performed by injecting steam in vertical wells, thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Electrical Resistance Heating	
		Thermal Conductive Heating	
	Mid-Temperature Thermal Treatment	Steam Injection	The subsurface is heated to temperatures near the boiling point of water, volatilizing or destroying (by pyrolysis) volatile organic compounds. Contaminated vapors are collected using soil vapor extraction, contaminated liquids are removed by pumping from wells, and contaminants are treated. Heating can be performed by injecting steam in vertical wells, thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Electrical Resistance Heating	
		Thermal Conductive Heating	
	High-Temperature Thermal Treatment	Thermal Conductive Heating	The subsurface is heated to temperatures above the boiling point of water, volatilizing or destroying (by pyrolysis) volatile and semi-volatile organic compounds. Contaminated vapors are collected using soil vapor extraction, contaminated liquids are removed by pumping from wells, and contaminants are treated. Heating can be performed by thermal conduction from vertical heated wells, or by electrical resistance when voltage is applied between subsurface electrodes.
		Vitrification	Soil is heated via electrical current to temperatures greater than 2,400°F, destroying contaminants and fusing soil into a glassy matrix.

Table 7-2 - Remedial Technologies for Soil

Bremerton Gas Works Superfund Site
Bremerton, Washington

Soil General Response Actions	Remedial Technology	Process Options	Description
In Situ Treatment	Stabilization	Solidification/ Stabilization	Soil or sediment is stabilized by adding amendments to solidify or immobilize contaminants. Potential amendments include polymers, pozzolans, and cement. Amendments can be mixed with soil <i>in situ</i> using large-diameter augers, soil mixers, or similar equipment.
	Chemical Treatment	Chemical oxidation	Chemical oxidation involves the injection of chemical oxidants into the subsurface to react with and destroy organic contaminants. Common oxidants include hydrogen peroxide, potassium permanganate, ozone, and sodium persulfate, which have been shown to destroy a wide range of contaminants in soil.
	Bioremediation	Bioventing	Bioventing supplies oxygen to unsaturated soil to increase aerobic biodegradation rates and may be designed to increase the air exchange rate through the soil.
		Amendment Injection	Biodegradation of contaminants by indigenous soil microbes can be enhanced by amending soil with nutrients, moisture, and oxygen (typically provided by injecting air or solutions into wells or trenches).
Removal	Excavation	Excavation	Excavators, backhoes, and other conventional earth moving equipment are the most common equipment used to remove contaminated soil from upland areas.
Ex-Situ Treatment	Physical	Solidification/ Stabilization	Amendments are added to excavated soil or sediment to immobilize and/or bind contaminants within the stabilized product. Depending on the proportion of amending agents, the end product may take on the form of a quasi-soil/concrete material that could later be used as bulk fill.
	Thermal	Co-Burning	Combustion of Manufactured Gas Plant residues, such as coal tar and tar contaminated soil, with coal in utility boilers and cement kilns.
		Thermal desorption	Low-temperature thermal desorption involves heating soils or sediments to temperatures between 200°F and 600°F until volatile and semivolatile chemicals of concern (COCs) such as benzene and naphthalene evaporate. Exhaust gases produced by the process are typically combusted.
		Incineration	When soil is heated to temperatures above 1,400°F, contaminants are directly oxidized.
	Chemical/ Physical	Particle washing	In particle washing, soil is put in contact with an aqueous solution to remove contaminants from the soil particles. The suspension is often also used to separate fine particles from coarser particles, allowing beneficial use of the coarser fraction (if sufficiently clean) at the Site.
		Solvent extraction	Solvent extraction is a variant of soil washing in which an organic solvent (rather than an aqueous solution) is put in contact with the soil to remove contaminants.
	Bioremediation	Landfarming	Microbial population potentially enhanced with nutrients, moisture, and bioaugmentation to treat contaminated soil on lined beds with tilling and irrigation.
		Biopiles	Microbial population potentially enhanced with nutrients, moisture, aeration, and bioaugmentation to treat contaminated soil in stockpiles.
		Bioreactor	Microbial population potentially enhanced with nutrients, moisture, aeration, and bioaugmentation to treat contaminated soil in enclosed reactor vessels.
Reuse	Asphalt Batching	Cold-Mix Asphalt Batching	Encapsulation of contaminant by blending residues, wet aggregate and asphalt emulsion at ambient temperature.
		Hot-Mix Asphalt Batching	Encapsulation of contaminant by blending residues, wet aggregate and asphalt emulsion at high temperature.
Disposal	Confined On-Site Disposal	Confined On-site disposal	Excavated soils exceeding applicable cleanup standards could potentially be placed on site in a specially designed upland confined disposal facility (CDF). Depending on the leachability of confined materials, the CDF could potentially include a liner and a liquid collection system to prevent leachate from contaminating groundwater.
	Off-Site Landfill Disposal	Subtitle D (Solid Waste)	Contaminated soils from the Site may be transported to an off-site, permitted disposal facility. This disposal method provides for secure, long-term containment of hazardous and non-hazardous solid wastes.
		Subtitle C (Hazardous Waste)	

Notes:

¹Institutional controls are not considered stand-alone remedial technologies but may be applied in conjunction with other cleanup technologies.

BTEX = benzene, toluene, ethylbenzene, and xylenes

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

NAPL = non-aqueous phase liquid

O&M = operation and maintenance

PAHs = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

Table 7-3 - Remedial Technologies for Groundwater
 Bremerton Gas Works Superfund Site
 Bremerton, Washington

Groundwater General Response Actions	Remedial Technology	Process Options	Description
Institutional Controls ¹	Deed Restrictions	Deed restrictions to preclude drinking water use	Covenant placed on property that limits or prohibits activities that may interfere with a cleanup action or result in exposure to hazardous substances.
		Deed restrictions addressing groundwater wells	
Monitored Natural Attenuation	Monitored Natural Attenuation	Groundwater Monitoring	Provides monitoring to document the presence and effectiveness of natural processes in removing or containing Site chemicals of concern (COCs).
<i>In-Situ</i> Containment	Vertical Barriers	Slurry Wall	Control lateral movement of contaminated groundwater by installing impermeable vertical barriers. Vertical barriers can be constructed of a variety of materials and installation techniques, including driving or vibrating steel sheet piling, excavation of a trench and backfilling with a low-permeability material (e.g., bentonite slurry), <i>in situ</i> mixing of bentonite with native soils, or pressure injecting hydraulic cement and bentonite.
		Sheet Pile Wall	
		Grout Curtain	
	Pumping	Pumping from vertical wells or trenches	Migration of contaminants dissolved in groundwater can be controlled by pumping groundwater from vertical wells or trenches, creating a capture zone within which groundwater flows toward the capture point.
	Stormwater Controls	Targeted Infiltration	A hydraulic barrier can be created by collecting and infiltrating stormwater and forming a local groundwater "mound."
		Reduced Infiltration	Hydraulic controls can reduce localized infiltration and seepage of stormwater in impacted areas along the shoreline.
<i>In-Situ</i> Treatment	Permeable Reactive Barrier	Sorptive/Reactive Wall	A 40-foot-deep trench may be excavated in the uplands and filled with a permeable material that sorbs dissolved-phase contaminants, facilitating further biodegradation and limiting contaminant migration toward marine sediment and surface water and offshore groundwater. A shallow trench could also excavated on the beach near the shoreline, but would be impacted by brackish water and tidally-influenced groundwater gradients.
	Chemical Treatment	Chemical Oxidation	Chemical oxidation involves the injection of oxidant solutions into saturated groundwater to react with and destroy organic contaminants. Common oxidants include hydrogen peroxide, potassium permanganate, ozone, and sodium persulfate.
	Bioremediation	Amendment Injection	Injecting compounds, such as peroxides, oxygen-releasing compound, or nutrients, that enhance degradation of contaminants.
		Biosparging	Biosparging involves the injection of oxygen, and sometimes nutrients, to groundwater to enhance aerobic bioattenuation of organic compounds. For volatile contaminants, soil vapor extraction or bioventing may be concurrently applied for unsaturated soil.
Removal	Groundwater Extraction	Pumping from Vertical Wells or Trenches	Groundwater can be removed from the subsurface by pumping fluids from wells or trenches.

Table 7-3 - Remedial Technologies for Groundwater
Bremerton Gas Works Superfund Site
Bremerton, Washington

Groundwater General Response Actions	Remedial Technology	Process Options	Description
Ex-Situ Treatment	Physical/ Chemical	Adsorption	Granular activated carbon (GAC) can be used to remove organic contaminants. Contaminated groundwater is passed through a bed of GAC, and hydrophobic organic compounds in solution adsorb onto the carbon until the carbon becomes depleted or saturated. Depleted GAC may be regenerated or disposed off Site.
		Air Stripping	Contaminated groundwater and air are typically passed counter-currently through a tower, and volatile contaminants (such as benzene and, to a lesser extent, naphthalene) transfer from the water to the air. The contaminant-laden air is usually treated by activated carbon and then discharged to the atmosphere.
		Advanced Oxidation Processes	Involves adding chemicals that directly oxidize organic contaminants in water. Process options include ozonation, hydrogen peroxide (with or without catalysts such as Fenton's Reagent or ultraviolet light), and permanganate.
	Biological	Biotreatment	Contaminated groundwater is passed through a biological reactor in which a contaminant-degrading microbial culture is maintained, generally by adding nutrients and oxygen and controlling temperature, pH, and other parameters. Process options include bioslurry reactors, fixed-film bioreactors, and constructed wetlands.
Disposal	Off-Site Management	Discharge to Sanitary Sewer	Groundwater is discharged to the local sanitary sewer system. Pre-treatment of groundwater may not be required if concentrations of chemicals of concern (COCs) meet discharge criteria. Water containing high concentrations of solids (e.g., from construction dewatering) would likely need to be passed through a settling tank or filter to meet discharge requirements.
		Discharge to Surface Water	Extracted groundwater may also be discharged to surface water, although this discharge option would likely require a National Pollutant Discharge Elimination System (NPDES) permit. Water discharged to surface water would have to meet strict water quality requirements and would likely require treatment before discharge.
	On-Site Management	Re-introduction to Groundwater	Extracted groundwater may also be discharged on site to groundwater via infiltration galleries or injection wells. Contaminated groundwater would likely require treatment before discharge via this method.

Notes:

¹Institutional controls are not considered stand-alone remedial technologies but may be applied in conjunction with other cleanup technologies.

BTEX = benzene, toluene, ethylbenzene, and xylenes
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
NAPL = non-aqueous phase liquid
O&M = operation and maintenance
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons

Table 7-4 - Remedial Technologies for Sediment

Bremerton Gas Works Superfund Site
Bremerton, Washington

Sediment General Response Actions	Remedial Technology	Process Options	Description
Institutional Controls ¹	Use Restrictions	Governmental advisories and public outreach on fish/shellfish consumption	Institutional controls are measures undertaken to limit or prohibit activities that may interfere with a cleanup action or result in exposure to hazardous substances.
		Easements or restrictive covenants to limit activities which may damage the remedy or increase the potential for exposure	
		Monitoring and notification of waterway users to restrict specific activities to protect the remedy	
Monitored Natural Recovery	Monitored Natural Recovery	Monitored Natural Recovery	A passive remedial approach which relies on monitoring of ongoing, natural processes (physical, biological, and/or chemical mechanisms) that act together to reduce the risk (bioavailability and/or toxicity) of the Site COCs. Monitoring is required to evaluate the effectiveness and frequently includes multiple lines of evidence.
	Enhanced Natural Recovery	Thin-Layer Sand Placement	Thin-layer placement normally accelerates natural recovery by adding a layer of clean sediment over contaminated sediment. The acceleration can occur through several processes, including increased dilution through bioturbation of clean sediment mixed with underlying contaminants. Thin-layer placement is typically different than the <i>in situ</i> isolation caps, because it is not designed to provide long-term isolation of contaminants from benthic organisms.
<i>In-Situ</i> Containment	Capping (Non-reactive)	Engineered Sand Cap	An engineered sand cap consists of a layer of granular material placed over contaminated sediments to contain and isolate them from the biologically active surface zone. Engineered caps may also include erosion protection or stability layers such as geosynthetics or armoring materials.
		Post-Dredge Residuals Management Layer	Similar to cap placement methods described above, with the exception that granular material is applied after dredging to manage residual contamination resulting from dredging. In some cases, a reactive media may be included in the residuals/backfill layer.
<i>In-Situ</i> Treatment	Physical/Chemical	Permeable Reactive Cap	A permeable reactive cap includes a reactive material (such as organoclay, coke, coal, or activated carbon) and similar to a sand cap is placed over contaminated sediments to isolate and contain the contaminated sediments. The reactive material also provides treatment by sorping or binding COCs (dissolved and/or NAPL) and further limiting migration into overlying sediment porewater and surface water.
		Stabilization	This technology involves adding amendments to in situ sediment that immobilize and/or bind contaminants within the stabilized media.
	Bioremediation	Amendment Injection	Biodegradation of contaminants by indigenous soil microbes can be enhanced by amending soil with nutrients, moisture, and oxygen (typically provided by injecting into wells or trenches).
Removal	Dredging	Hydraulic	Dredging is the removal of sediment in the wet and is primarily accomplished with hydraulic or mechanical equipment. Hydraulic dredging removes and transports sediment with entrained water in a slurry. Mechanical dredging uses mechanical equipment/force to dislodge and excavate sediment in the wet. Dredging effectiveness may be limited by resuspension, release of COCs (i.e., dissolved, particles, and sheens) to water and volatilization to air during dredging, and residual COCs remaining after dredging (USACE 2008). These effects may be reduced by use of containment (e.g., sheet pile, silt curtains) and best management practices.
		Mechanical	

Table 7-4 - Remedial Technologies for Sediment

Bremerton Gas Works Superfund Site
Bremerton, Washington

Sediment General Response Actions	Remedial Technology	Process Options	Description
Ex-Situ Treatment	Physical	Physical Separation	The volume of excavated or dredged contaminated materials may be reduced by physically separating the materials into two or more fractions that can be handled separately.
		Stabilization	This technology involves adding amendments to excavated sediment that immobilize and/or bind contaminants within the stabilized media.
	Thermal	Thermal Desorption	Low-temperature thermal desorption involves heating soils or sediments to temperatures between 200°F and 600°F until volatile and semivolatile COCs such as benzene and naphthalene evaporate. Exhaust gases produced by the process are typically combusted.
		Incineration	When sediment is heated to temperatures above 1,400°F, contaminants are directly oxidized.
Disposal	On-Site Beneficial Use	Sand/Aggregate Reclamation	Dredged material with high sand contents that undergo particle separation may be available for use as concrete aggregate or general upland fill.
		Topsoil Feedstock	Dredged material may be used as non-organic feedstock for topsoil (i.e., material would be blended with organics).
	Confined On-Site Disposal	Confined On-site Disposal	Removed sediments exceeding applicable cleanup standards could potentially be placed on Site in a specially designed upland CDF. Depending on the leachability of confined materials, the CDF could potentially include a liner and a liquid collection system to prevent leachate from contaminating groundwater.
		Near-shore Confined Disposal Facility (CDF)	Removed sediments exceeding applicable cleanup standards could potentially be placed on Site in a specially designed CDF built along the shoreline. Construction would require significant filling and conversion of aquatic lands.
		Contained Aquatic Disposal (CAD)	Dredged sediments may be consolidated and disposed of in a deep aquatic excavation adjacent to the Site and capped with clean material.
	Off-Site Landfill Disposal	Subtitle D (Solid Waste)	Contaminated sediments from the Site may be transported to an off-Site, permitted disposal facility. This disposal method provides for secure, long-term containment of hazardous and non-hazardous solid wastes.
		Subtitle C (Hazardous Waste)	

Notes:

¹Institutional controls are not considered stand-alone remedial technologies but may be applied in conjunction with other cleanup technologies.

BTEX = benzene, toluene, ethylbenzene, and xylenes

COCs = chemicals of concern

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

NAPL = non-aqueous phase liquid

O&M = operation and maintenance

PAHs = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

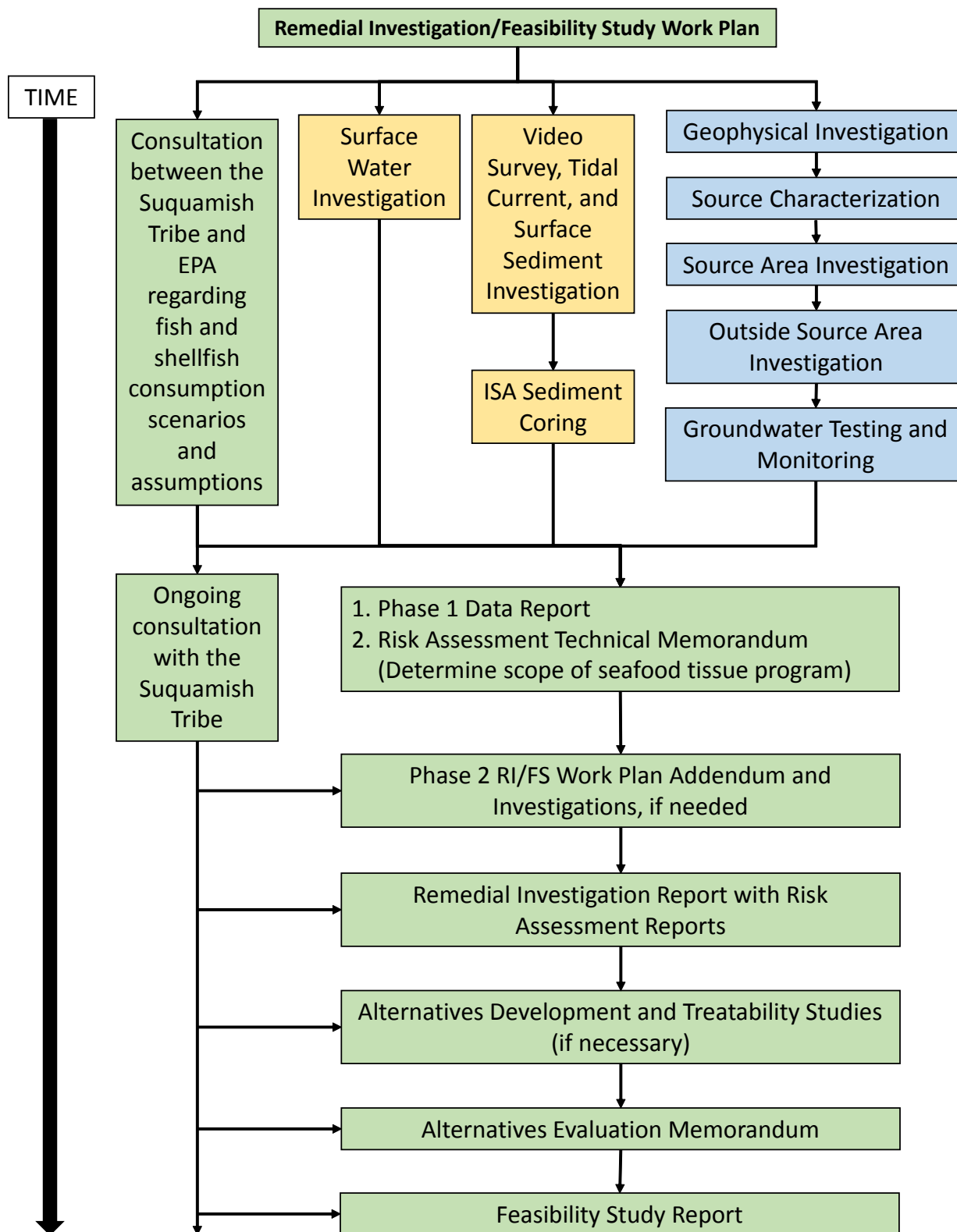
References: U.S. Army Corps of Engineers (USACE), 2008, Technical Guidelines for Environmental Dredging of Contaminated Sediments, ERDC/EL TR-08-29, September 2008.

Table 8-1 - Estimated Remedial Investigation Data Collection Schedule

Bremerton Gas Works Superfund Site
Bremerton, Washington

Task	Estimated Task Duration (Calendar Days)	Time to Completion (Days from Work Plan Approval)	Estimated Completion Date
Work Plan Approval Date			May 26, 2017
Upland Investigation			
Contractor coordination and mobilization	30	30	June 25, 2017
Geophysical Investigation	15	45	July 10, 2017
Source Characterization	90	135	October 8, 2017
Source Area Investigation	120	255	February 5, 2018
Outside Source Area Investigation	150	405	July 5, 2018
Groundwater Testing and Monitoring	270	675	April 1, 2019
Marine Area Investigations			--
Towed camera video survey (tidal dependent)	10	365	May 26, 2018
ADCP Current Survey (tidal dependent)	2	365	May 26, 2018
Surface Sediment Sampling within ISA (tidal dependent)	14	60	July 25, 2017
Shellfish Survey (tidal dependent)	7	60	July 25, 2017
Surface Sediment Sampling within Port Washington Narrows	7	60	July 25, 2017
Subsurface Sediment Investigation	10	180	November 22, 2017
Surface Water Sampling	365	365	May 26, 2018
Phase 1 Data Report			--
Phase I Data Report (includes WP Addendum, if applicable)	90	765	June 30, 2019
Risk Assessment Technical Memorandum (includes tissue sampling scope & methodology)	90	765	June 30, 2019
Tissue Sampling	60	825	August 29, 2019

FIGURES



LEGEND

- Programmatic/Risk Elements
- Marine Elements
- Upland Elements


Remedial Investigation/Feasibility Study Work Flow

Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington




FIRM:
ANCHOR QEA
DRAWN BY:
ckiblinger


FIGURE NO.
1-2




Parcels of Interest



Kitsap County Tax Parcel Line




Former Gas Works Property





Industrial Land Use





Generalized Zoning for City of Bremerton

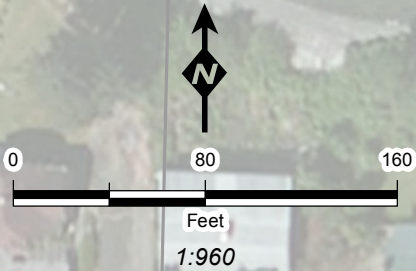
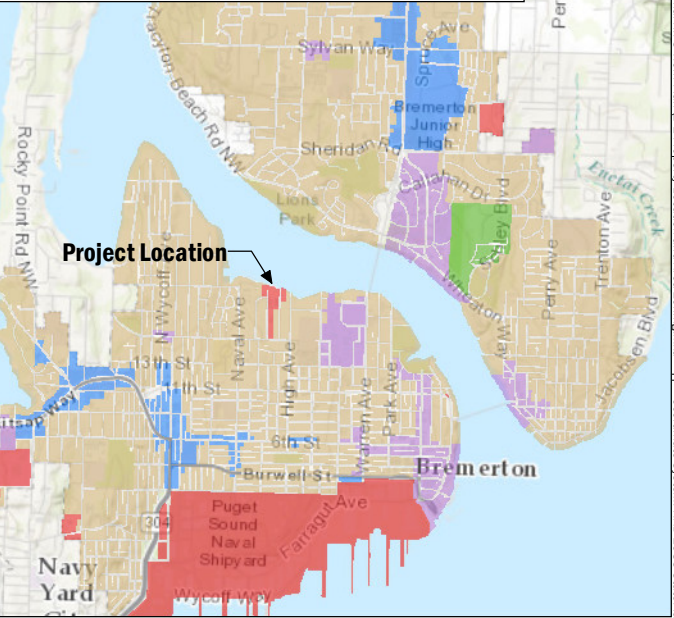
 Commercial

 Industrial

 Mixed

 Park

 Residential

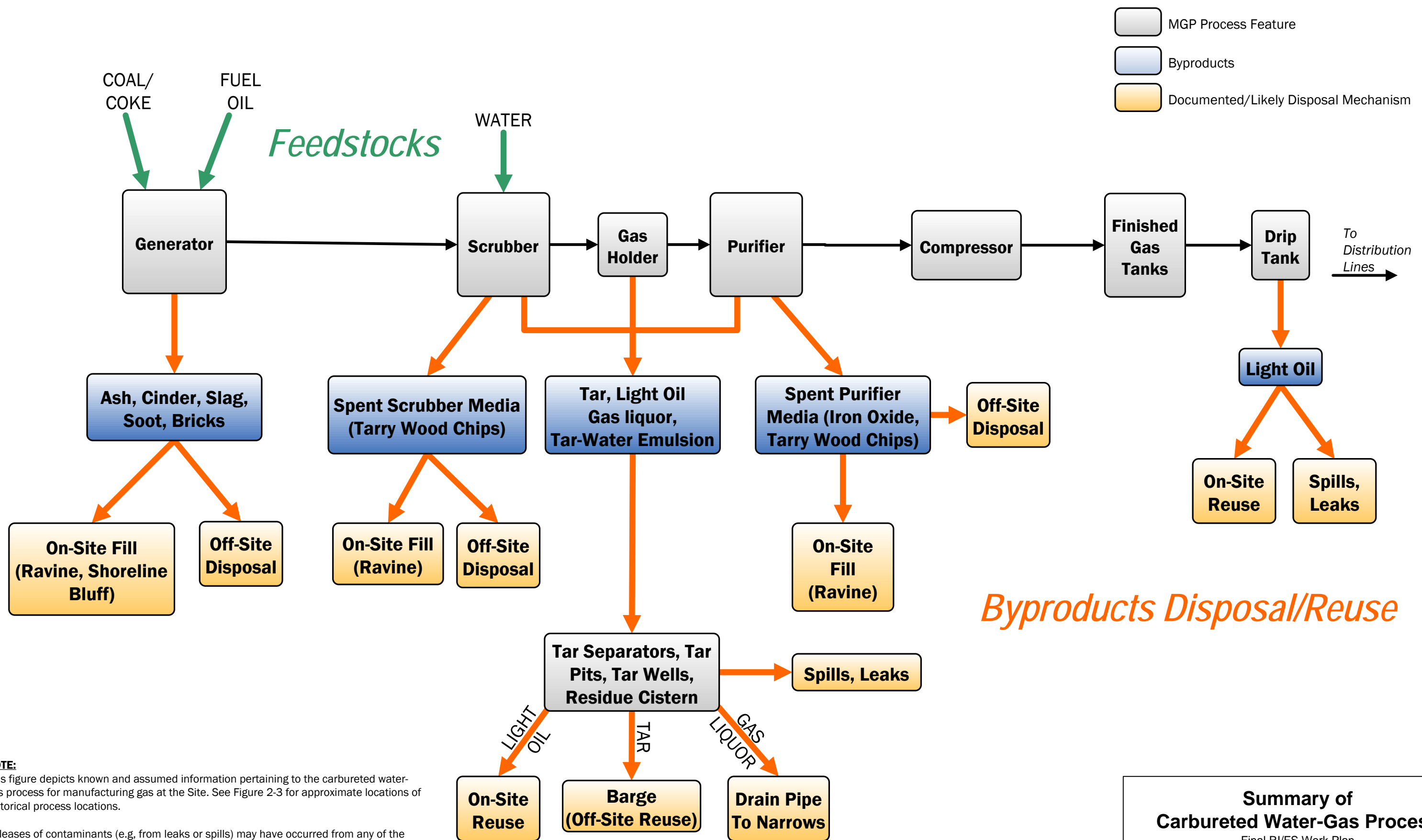


Property Location and Area Zoning
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



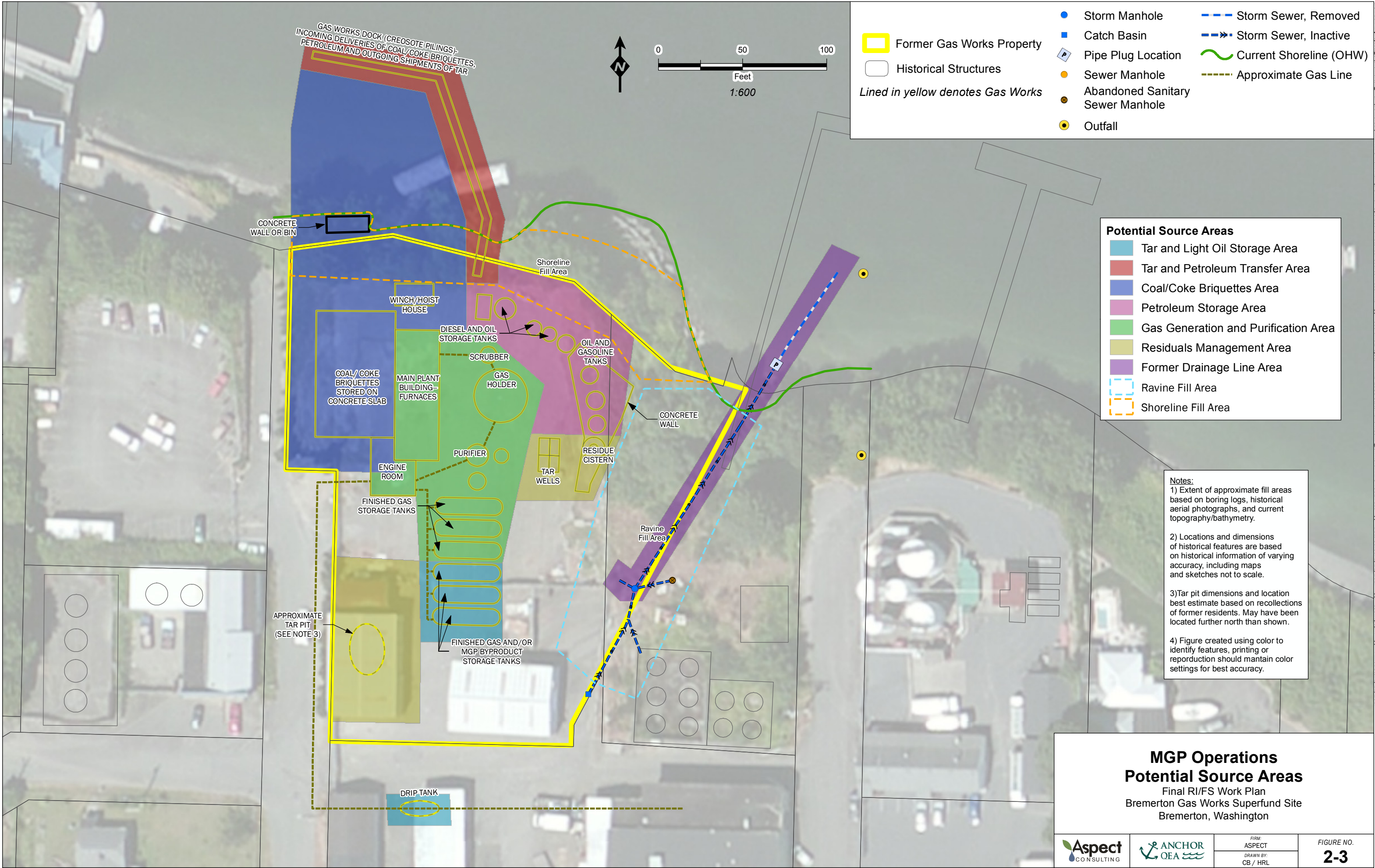
FIRM:
ASPECT
DRAWN BY:
JJP / HRL

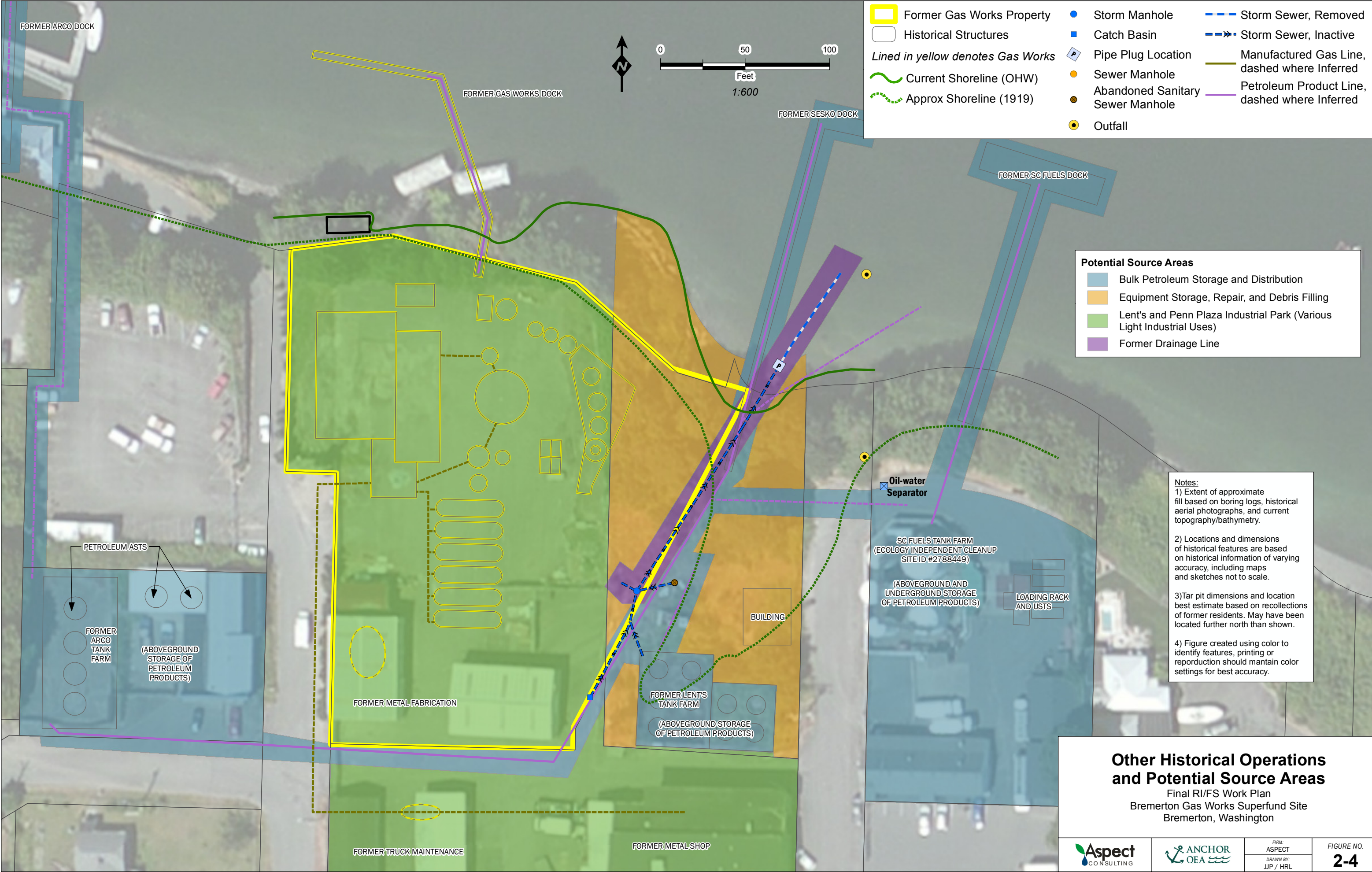
FIGURE NO.
2-1

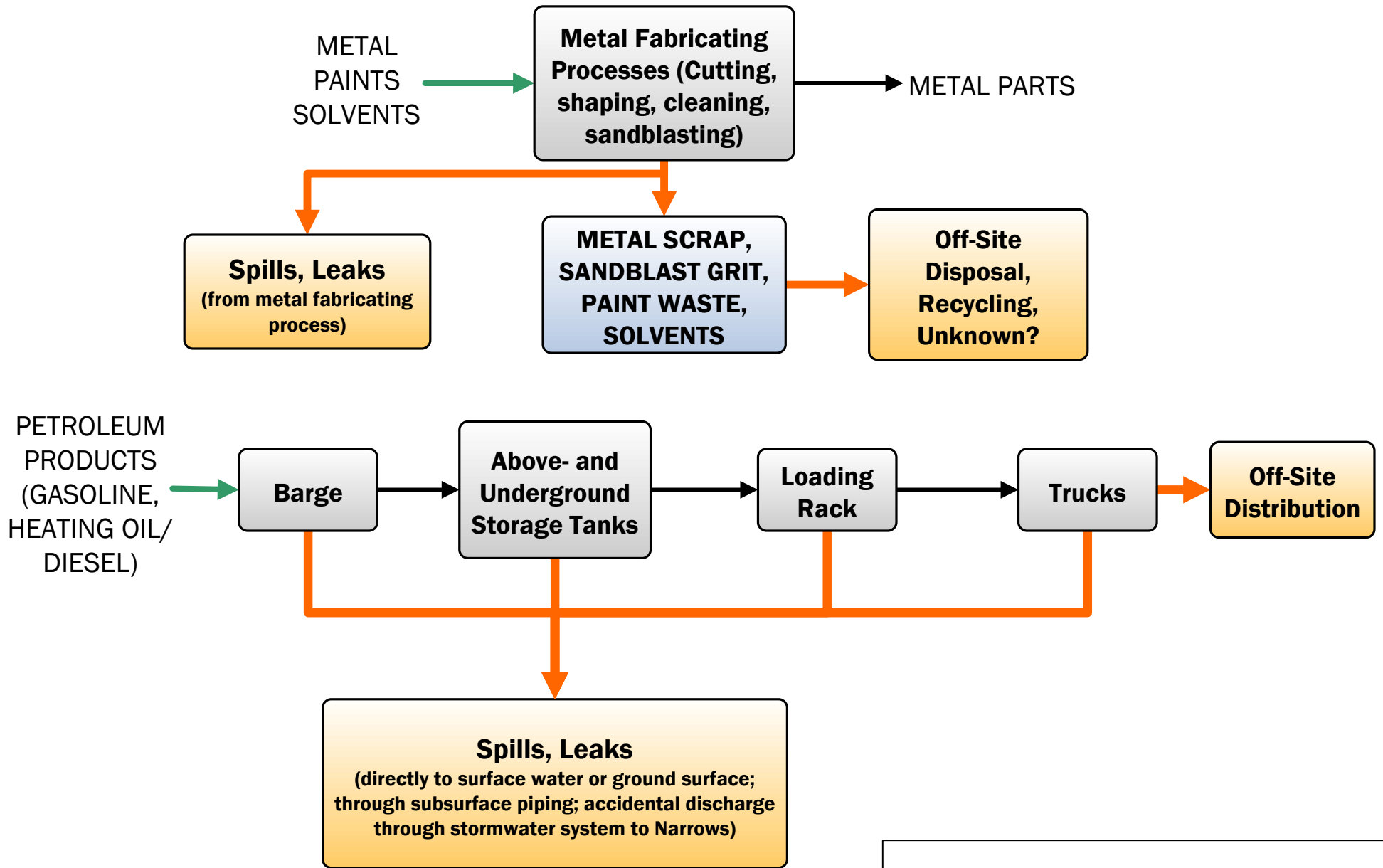





NOTE:
This figure depicts known and assumed information pertaining to the carbureted water-gas process for manufacturing gas at the Site. See Figure 2-3 for approximate locations of historical process locations.

Releases of contaminants (e.g. from leaks or spills) may have occurred from any of the illustrated process steps. Byproduct disposal or releases may also have occurred at undocumented locations within or outside of the gas works operational area. Refer to Section 5 – Preliminary Conceptual Model for discussion of potential sources of contamination and release mechanisms.







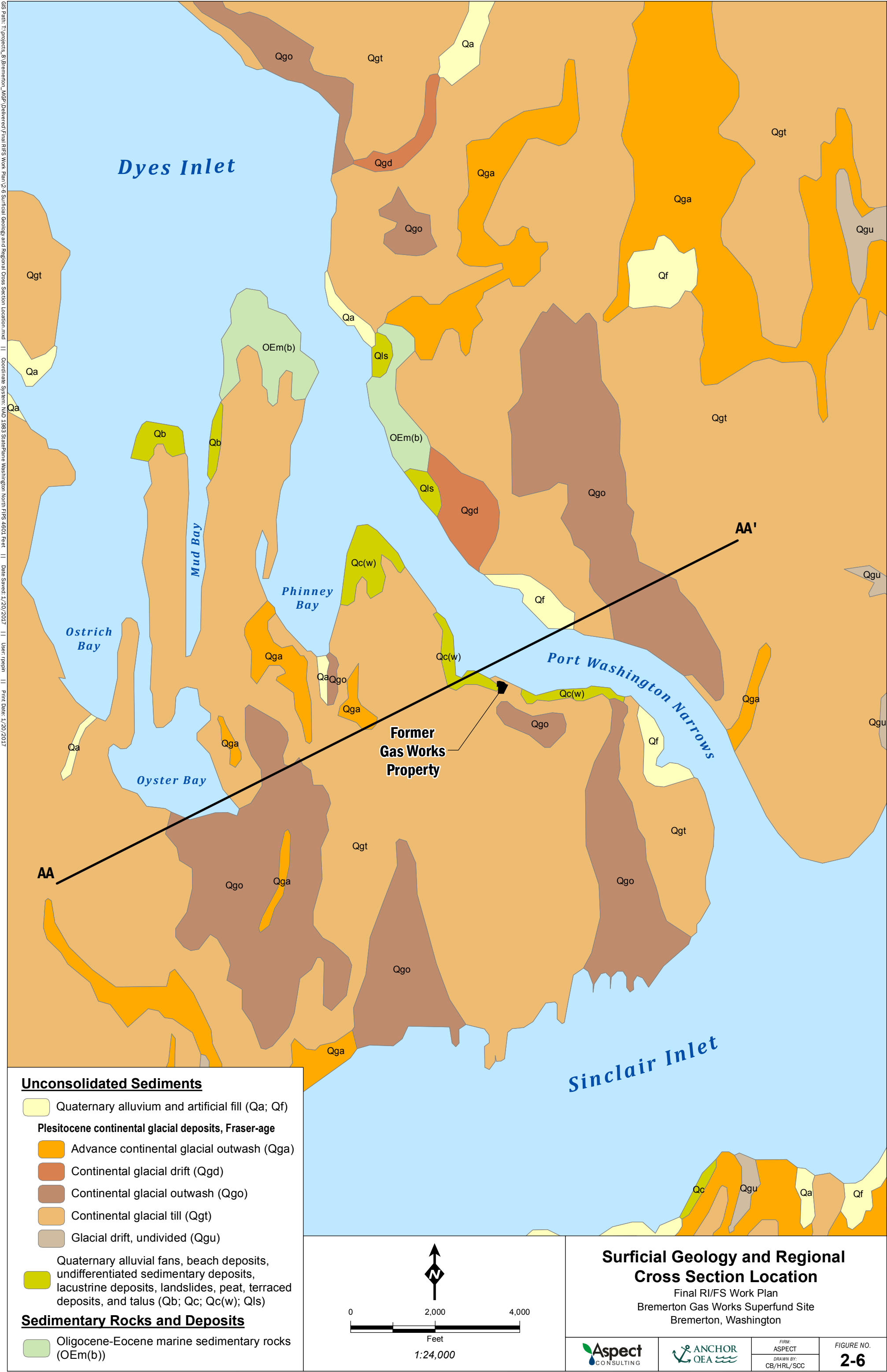


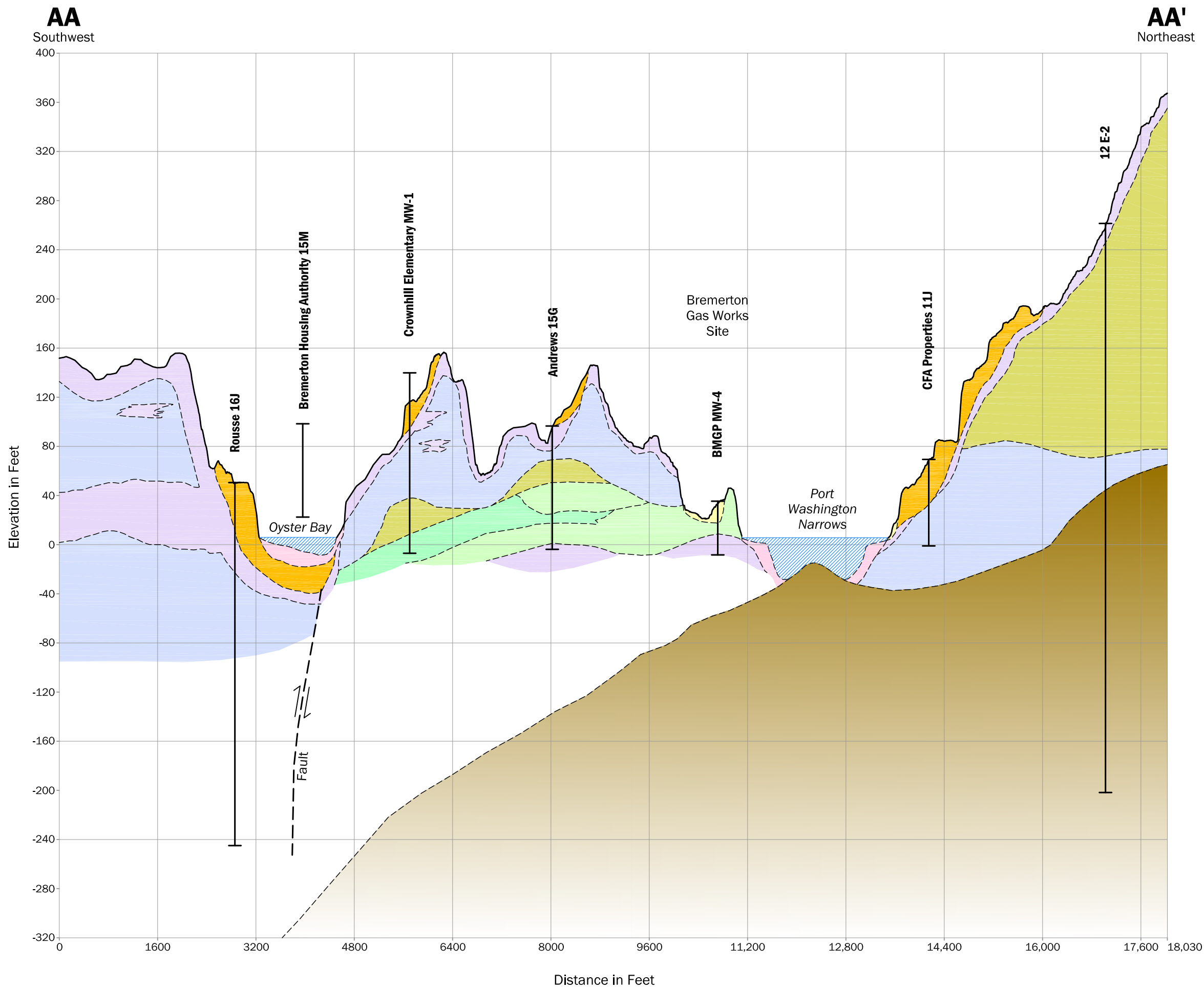
-  Industrial Process Feature
-  Byproducts
-  Documented/Likely Disposal Mechanism

Other Historical Industrial Processes

Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, State

		FIRM: ASPECT	FIGURE NO. 2-5
		DRAWN BY: JJP / HRL	





- Legend**
- Fill
 - Marine Sediments - Silt, Sand & Mud
 - Recessional Glacial Outwash - Sand & Gravel
 - Glacial Till - Silt, Sand & Gravel
 - Advance Glacial Outwash - Sand & Gravel
 - Glaciolacustrine Deposits - Silt & Clay
 - Non-Glacial Fluvial Deposits - Sand
 - Non-Glacial Lacustrine Deposits - Silt, Fine Sand & Clay
 - Undifferentiated Quaternary Deposits
 - Bedrock

Rouse 16J

Well or Soil Boring Log and Approximate Projected Location (See Appendix C)

Horizontal Scale: 1" = 1600'
 Vertical Scale: 1" = 80'
 Vertical Exaggeration 20x

**Conceptual Regional Geologic
Cross Section AA-AA'**

Final RI/FS Work Plan

Bremerton Gas Works Superfund Site

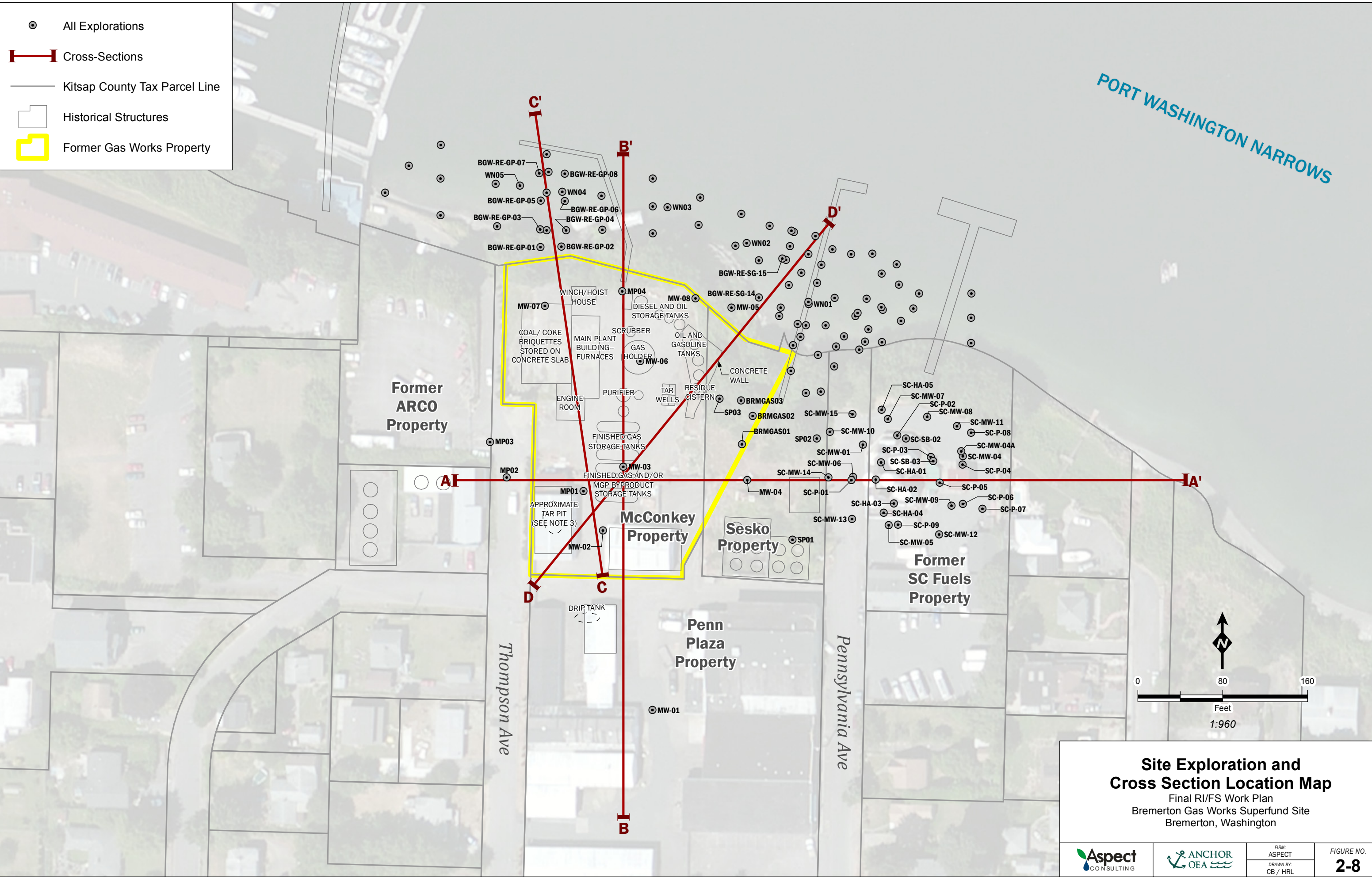
Bremerton, Washington

FIRM:
ASPECT

DRAWN BY:
SCC

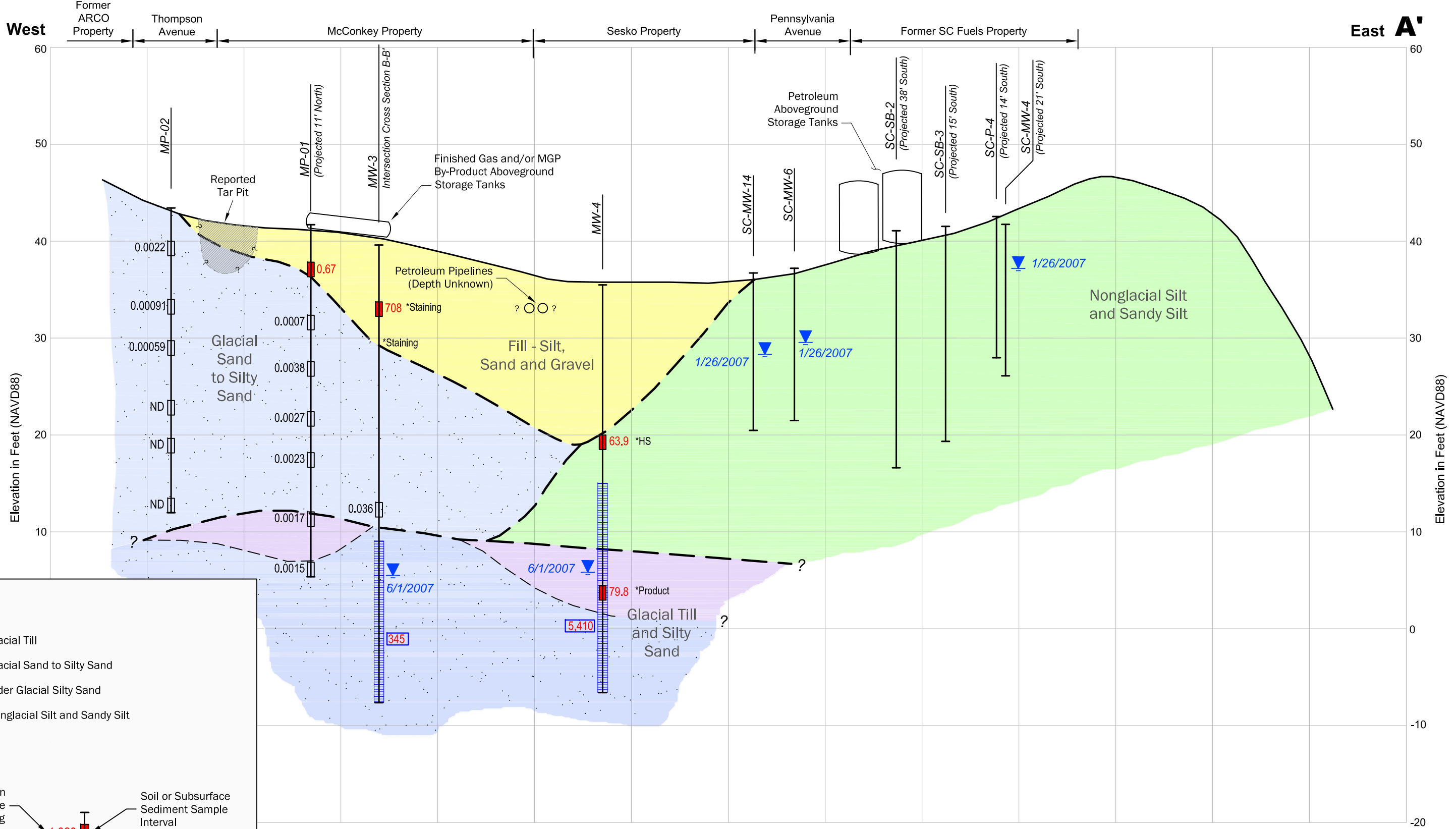
FIGURE NO.

2-7



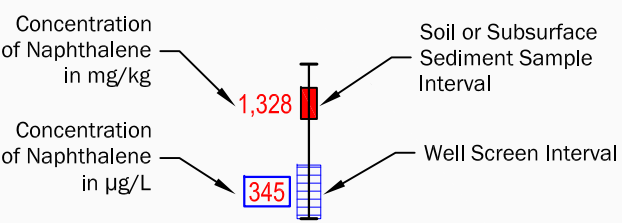
A West

East A'



Legend

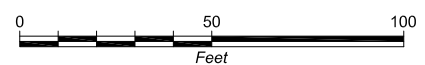
- Glacial Till
- Glacial Sand to Silty Sand
- Older Glacial Silty Sand
- Nonglacial Silt and Sandy Silt
- Fill



Red indicates concentration of naphthalene above the applicable PRG.

ND = Not detected above lab detection limit.

HS = Heavy Sheen



Scale: 1" = 50' Horizontal
1" = 10' Vertical
Vertical Exaggeration = 5X

Note: Information from the former SC Fuels Property used only for the interpretation of geologic and hydrogeologic conditions.

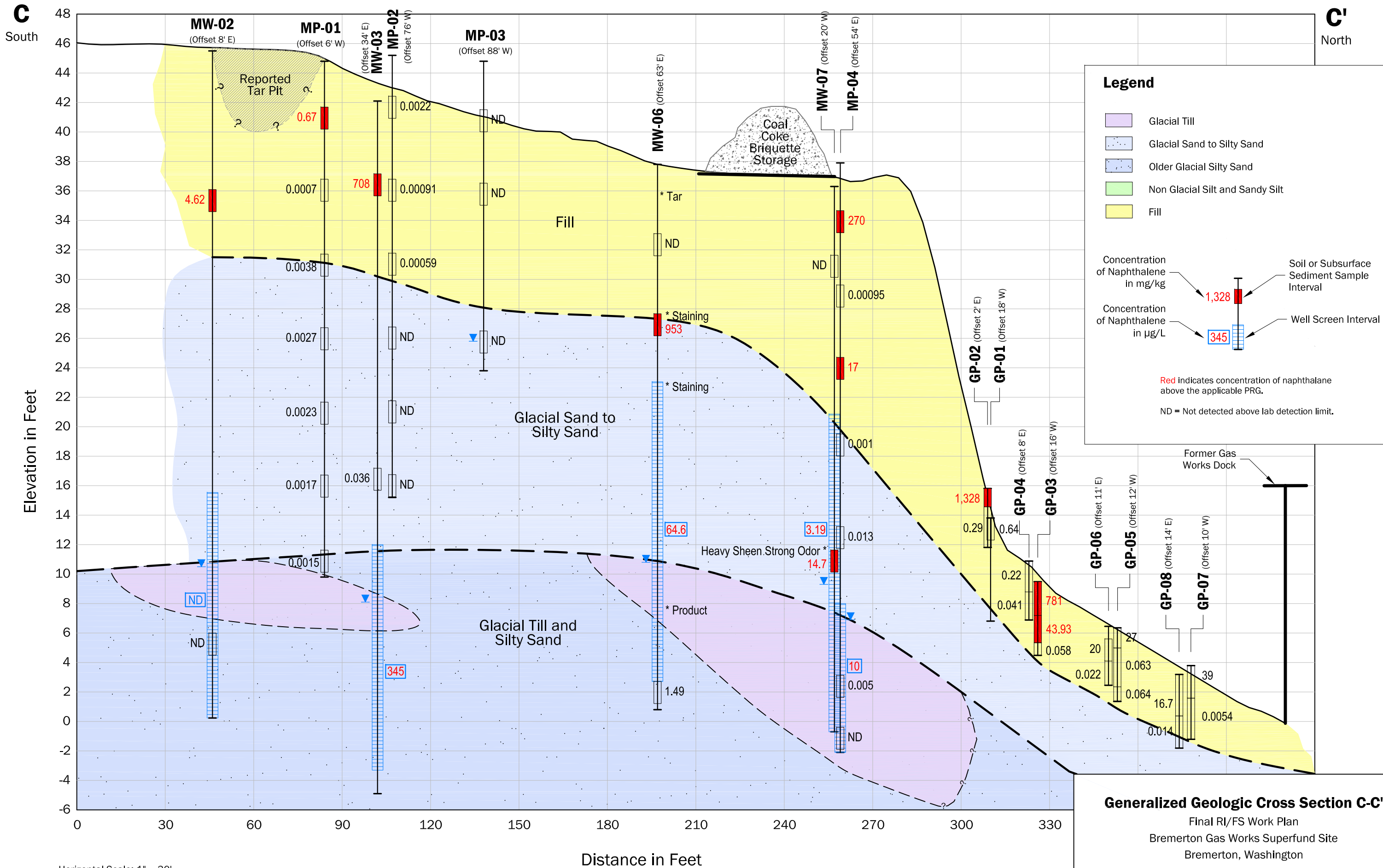
Generalized Geologic Cross Section A-A'

Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



FIRM: ASPECT
DRAWN BY: SCC

FIGURE NO.
2-9



Horizontal Scale: 1" = 30'
Vertical Scale: 1" = 6'
Vertical Exaggeration 5x

0 30 60
Feet

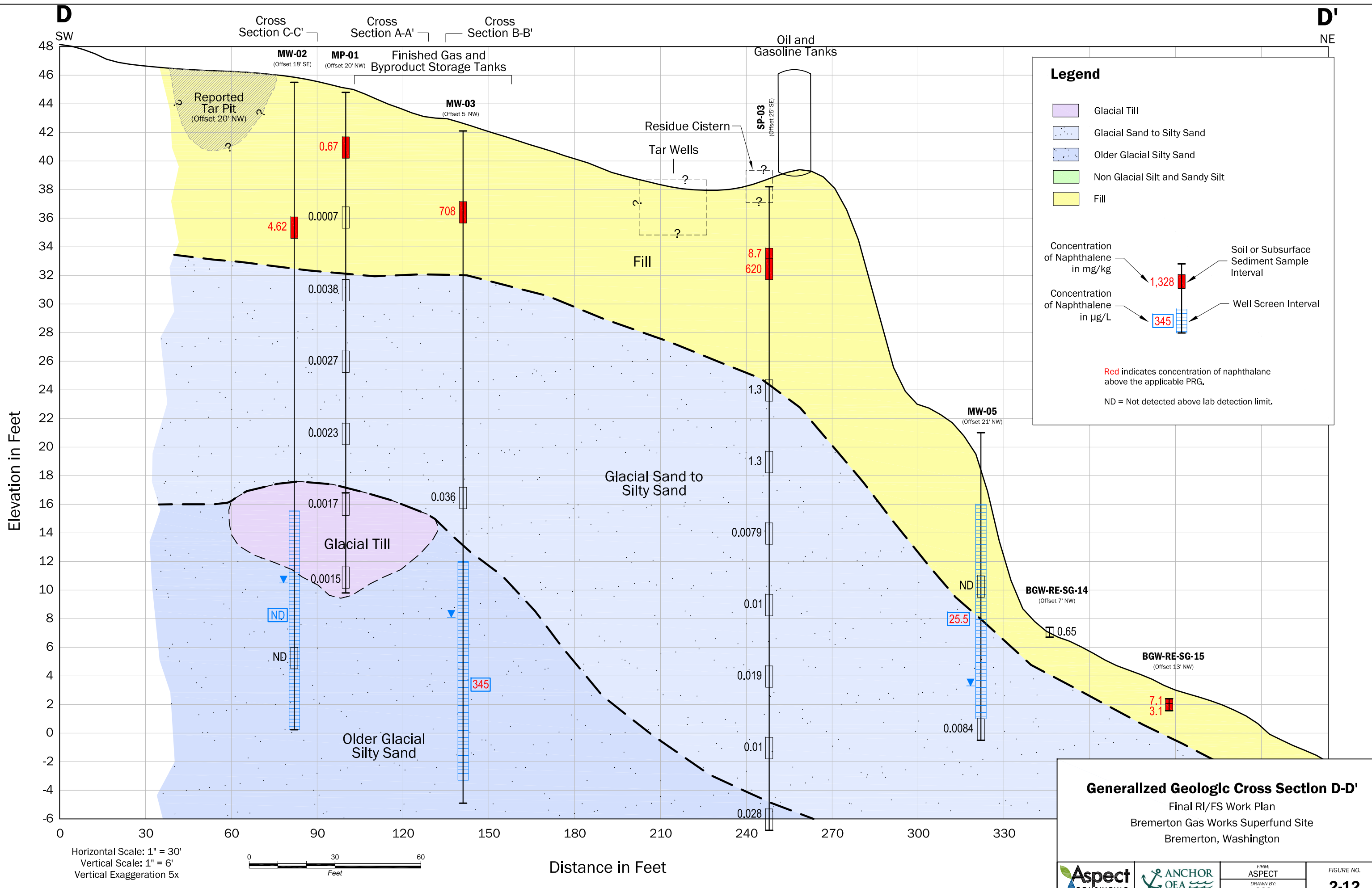
Generalized Geologic Cross Section C-C'
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

FIRM:
ASPECT

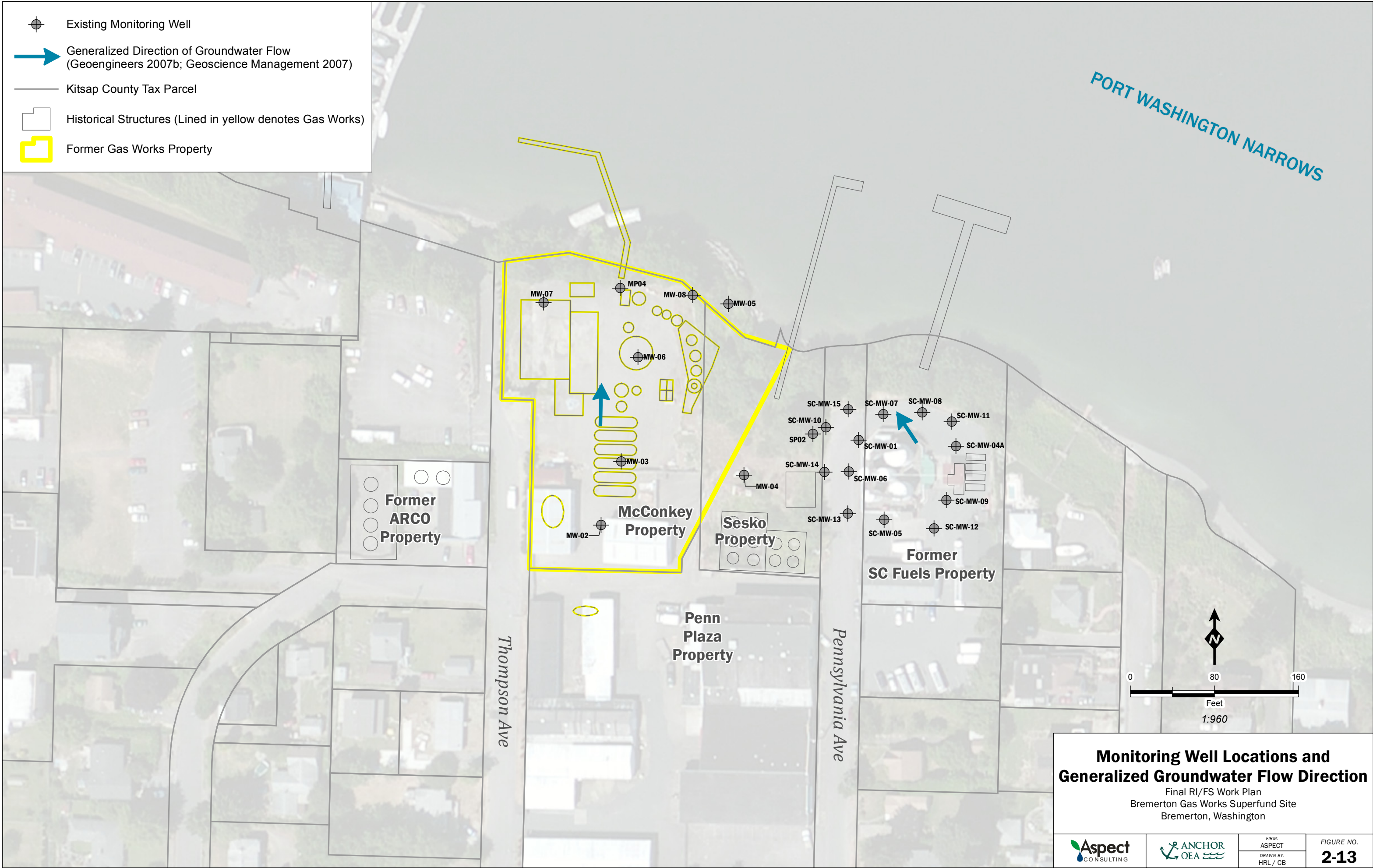
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SCC

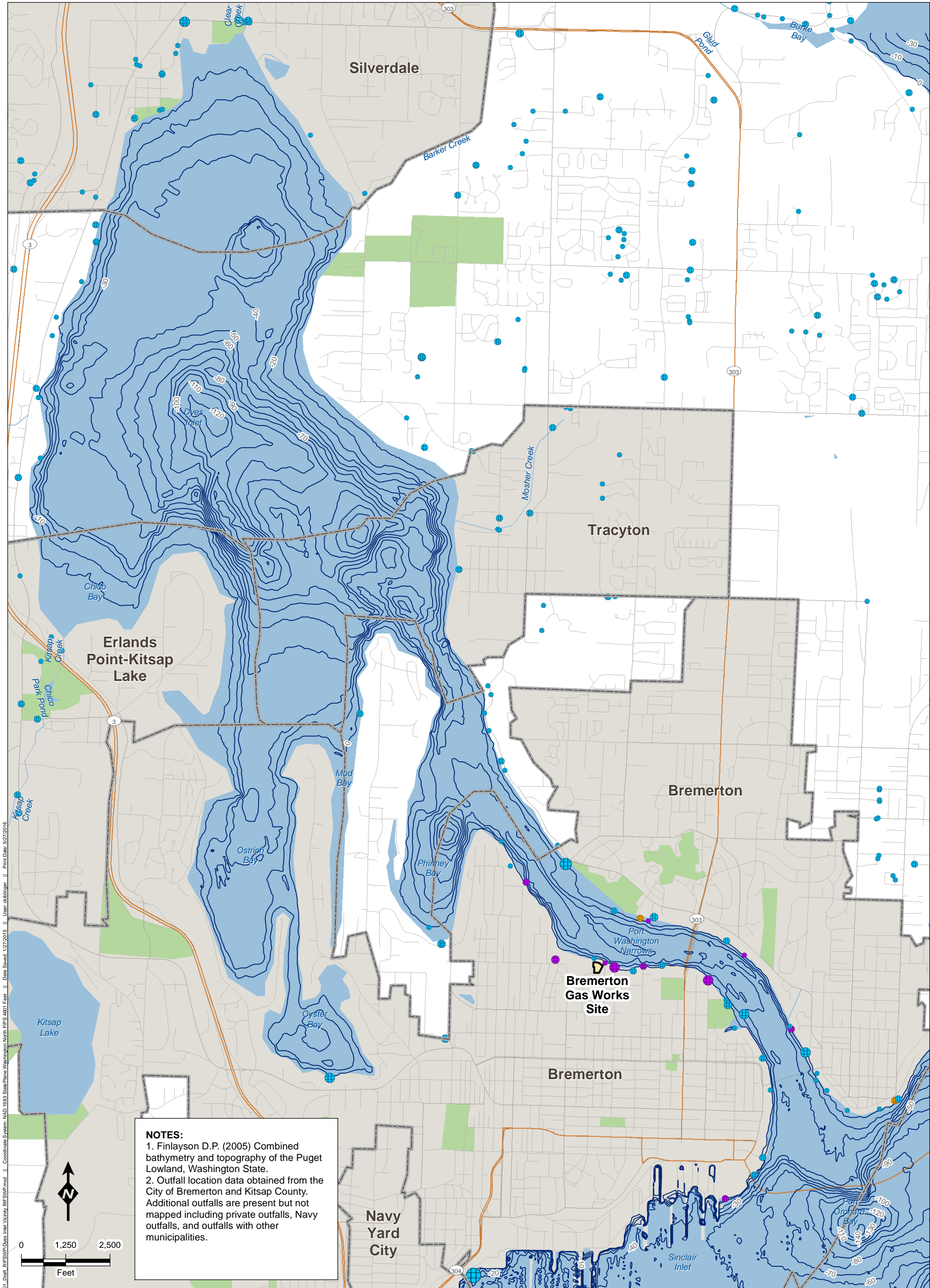
FIGURE NO.
2-11

CAD Path: Q:\Bremerton MGP\080239-Bremerton MGP\2017-01-Final RI/FS Work Plan\080239-CC.dwg Cross Section C-C' || Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet || Date Saved: Jan 31, 2017 4:46pm || User: scudd



CAD Path: Q:\Bremerton MGP\080239-DP\SITE.dwg 03-Cross Section A | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet | Date Saved: Jan 31, 2017 4:48pm | User: scud





NOTES:
1. Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. Outfall location data obtained from the City of Bremerton and Kitsap County. Additional outfalls are present but not mapped including private outfalls, Navy outfalls, and outfalls with other municipalities.

- Interstates
- Highways
- PSDEM 2005 10-foot Contours¹
- Parks
- Bremerton Gas Works Site
- Cities
- Unincorporated Areas
- City Limits

- Outfall Type²
- Combined Storm Drain/CSO Outfall
 - CSO Outfall
 - Storm Drain

- Outfall Size (inches)
- 8 - 12
 - 13 - 24
 - 25 - 36
 - 37 - 48
 - 49 - 60
 - 61 - 72
 - 73 - 84

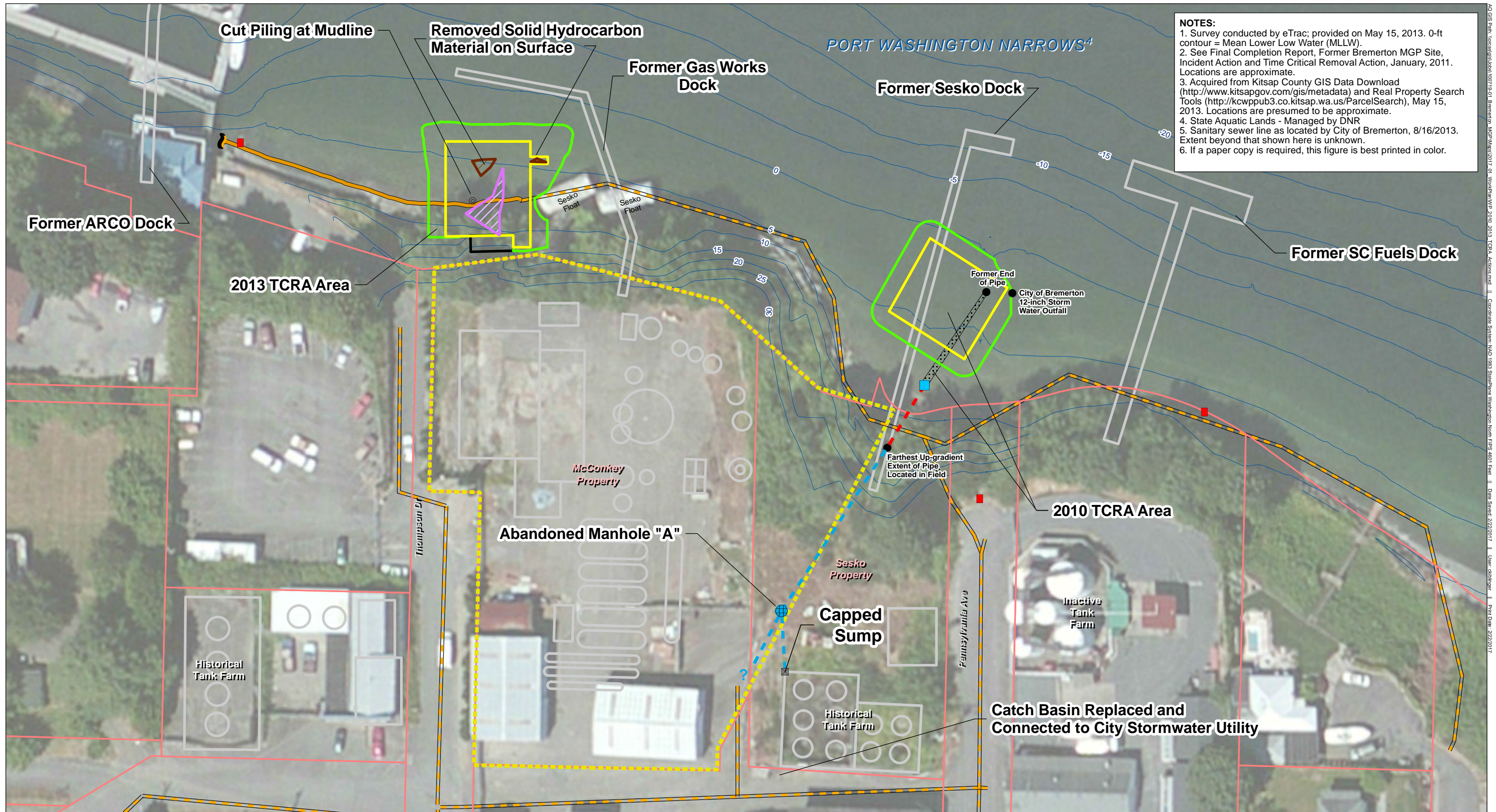
Dyes Inlet and Port Washington Narrows Bathymetry and Outfall Locations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



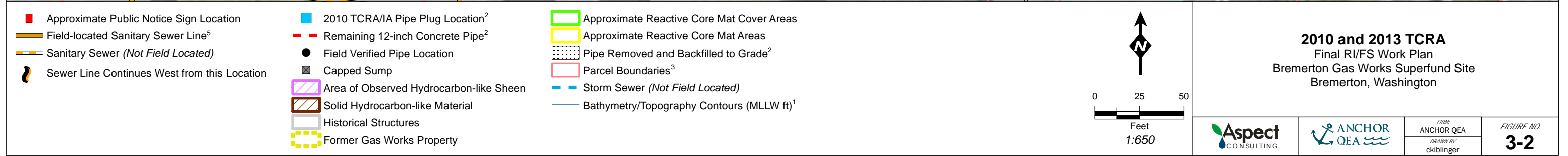
FIRM
ANCHOR QEA
DRAWN BY:
ckiblinger

FIGURE NO.
2-14

AO GIS Path: G:\Users\100719-01_Bremerton_MGP\Map\2015_01_Draft_RI/FS\WP\Dyes Inlet_Vect\RI/FSWP.mxd | Coordinate System: NAD 1983 StatePlane Washington North FIPS 4801 Feet | Date Saved: 12/2/2015 | User: ckiblinger | Print Date: 5/27/2016



NOTES:
1. Survey conducted by eTrac; provided on May 15, 2013. 0-ft contour = Mean Lower Low Water (MLLW).
2. See Final Completion Report, Former Bremerton MGP Site, Incident Action and Time Critical Removal Action, January, 2011. Locations are approximate.
3. Acquired from Kitsap County GIS Data Download (<http://www.kitsapgov.com/gis/metadata>) and Real Property Search Tools (<http://kcwppub3.co.kitsap.wa.us/ParcelSearch>), May 15, 2013. Locations are presumed to be approximate.
4. State Aquatic Lands - Managed by DNR
5. Sanitary sewer line as located by City of Bremerton, 8/16/2013. Extent beyond that shown here is unknown.
6. If a paper copy is required, this figure is best printed in color.



Sample Location with No Data

< 1.2 mg/kg

> 1.2 mg/kg

Exploration ID

MW-1

(3.4)

Maximum Benzene Concentration (in mg/kg)

• 1.2 mg/kg = surface soil Initial Preliminary Remediation Goal (PRG)

• Initial PRG is the lowest of applicable ecological and human health risk-based screening levels

• Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

Kitsap County Tax Parcel Line

Former Gas Works Property

Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Benzene Concentrations

- Sample Location with No Data
- < 1.2 mg/kg
- > 1.2 mg/kg

Exploration ID

MW-1 (3.4)

Maximum Benzene Concentration (in mg/kg)

- 1.2 mg/kg = surface soil Initial Preliminary Remediation Goal (PRG)
- Initial PRG is the lowest of applicable ecological and human health risk-based screening levels
- Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

- Kitsap County Tax Parcel Line
- Former Gas Works Property
- Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Map Labels:

- PORT WASHINGTON NARROWS
- Current Shoreline (OHW)
- BGW-RE-HA-01
- BGW-RE-GP-01
- MW-8
- MW-5
- MW-7 (0.102U)
- MP04 (0.001U)
- MW-6 (0.000958U)
- SP03 (12)
- Sesko Property
- MP03 (0.00091U)
- MP02 (0.0011U)
- MW-3 (1.93)
- MP01 (0.0013U)
- MW-2
- McConkey Property
- APPROX TAR PIT
- SP02 (0.0014U)
- SP01 (0.0022)
- MW-4
- Penn Plaza Property
- D RIP TANK
- MW-1 (0.000911U)
- Thompson Ave
- Pennsylvania Ave

Scale: 0, 50, 100 Feet. 1:600

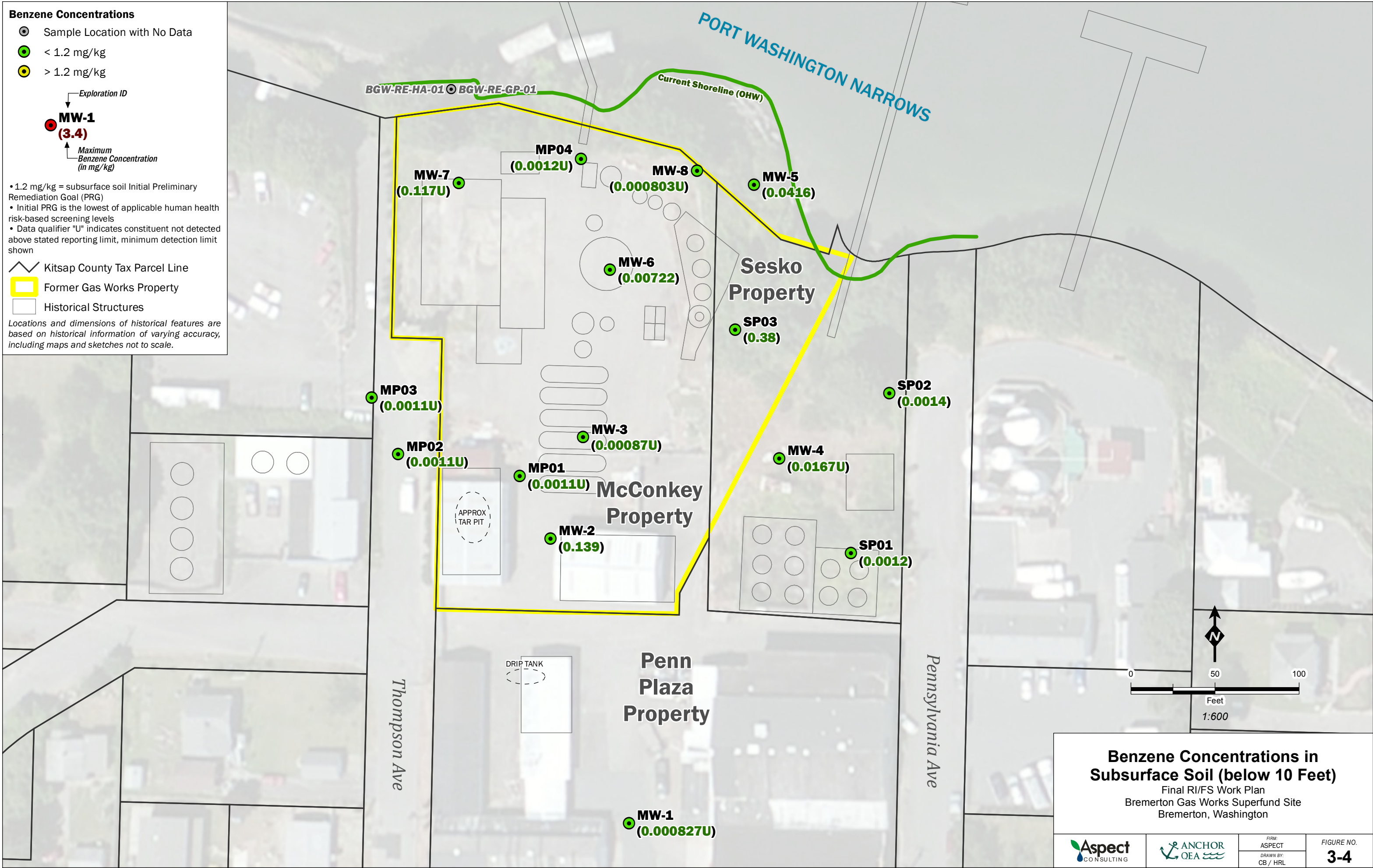
North Arrow

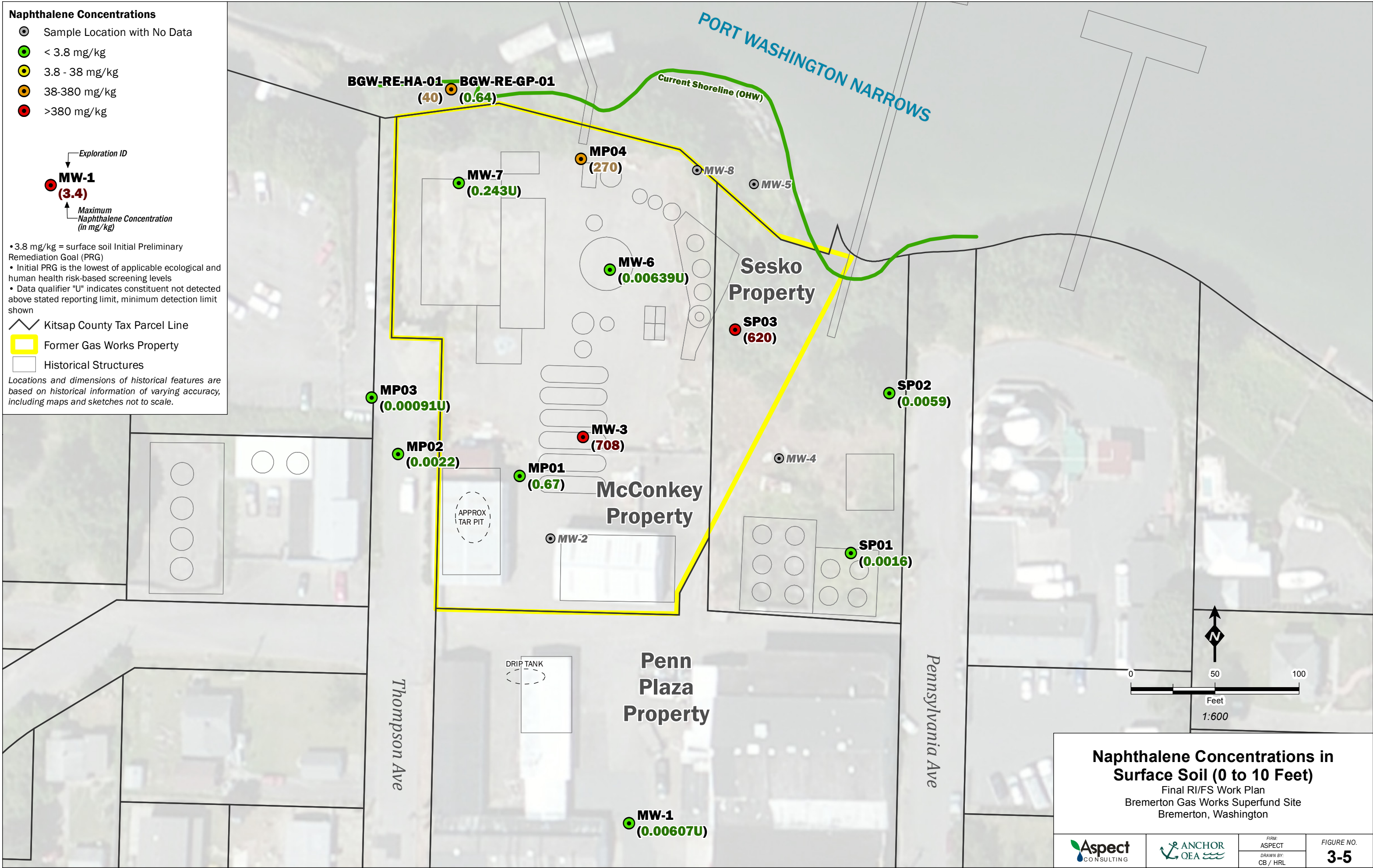
Figure Title: Benzene Concentrations in Surface Soil (0 to 10 Feet)
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Aspect CONSULTING	ANCHOR OEA	FIRM: ASPECT	FIGURE NO. 3-3
		DRAWN BY: CB/HRL/EAC	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: I:\Projects_8\Bremerton_MGP\Deliverables\Final RI/FS Work Plan\3-3 Benzene surface soil.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/20/2017 || User: mapin || Print Date: 1/20/2017





- Sample Location with No Data
- < 3.8 mg/kg
- 3.8 - 38 mg/kg
- 38 - 380 mg/kg
- >380 mg/kg

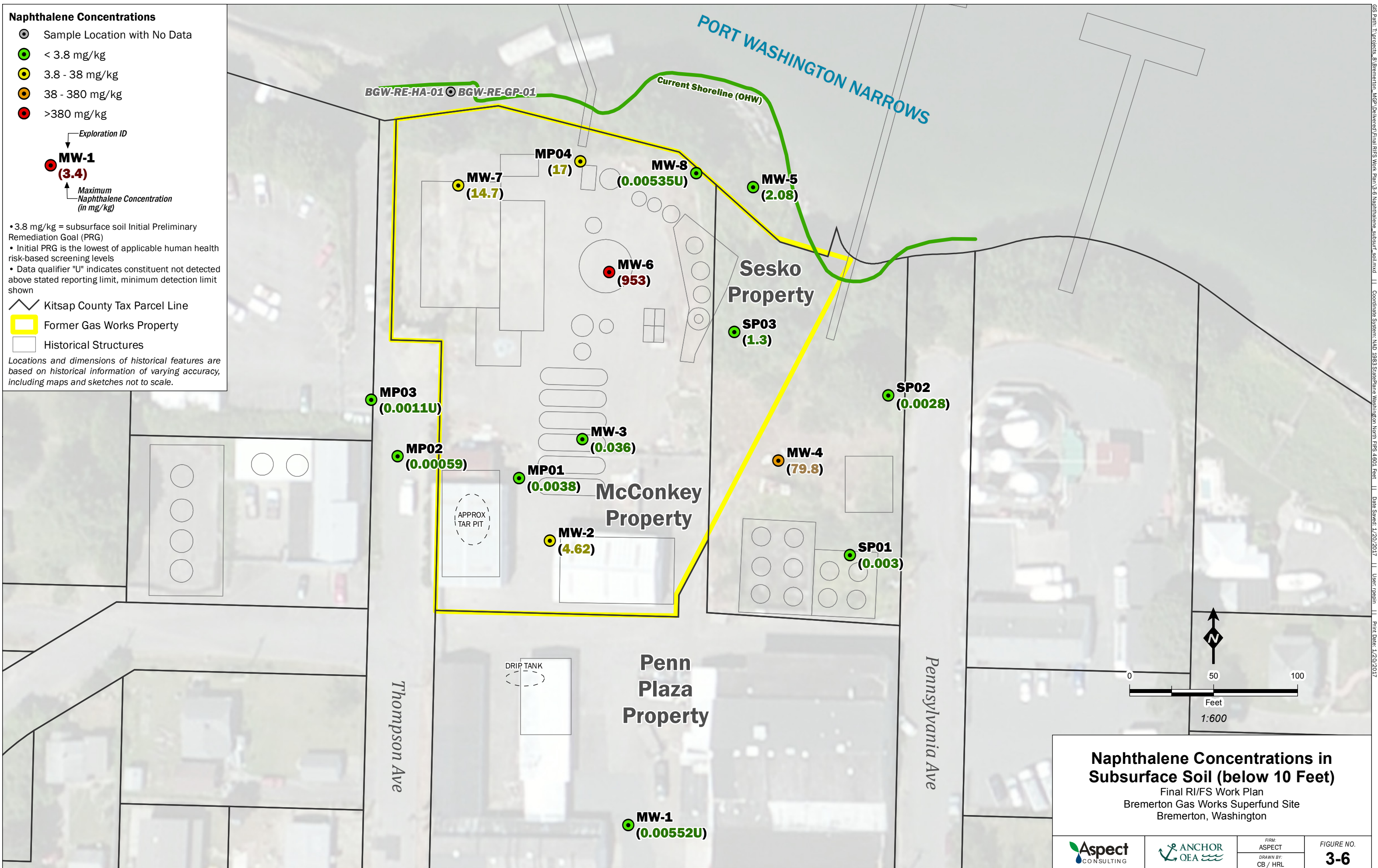
MW-1
(3.4)
Maximum
Naphthalene Concentration
(in mg/kg)

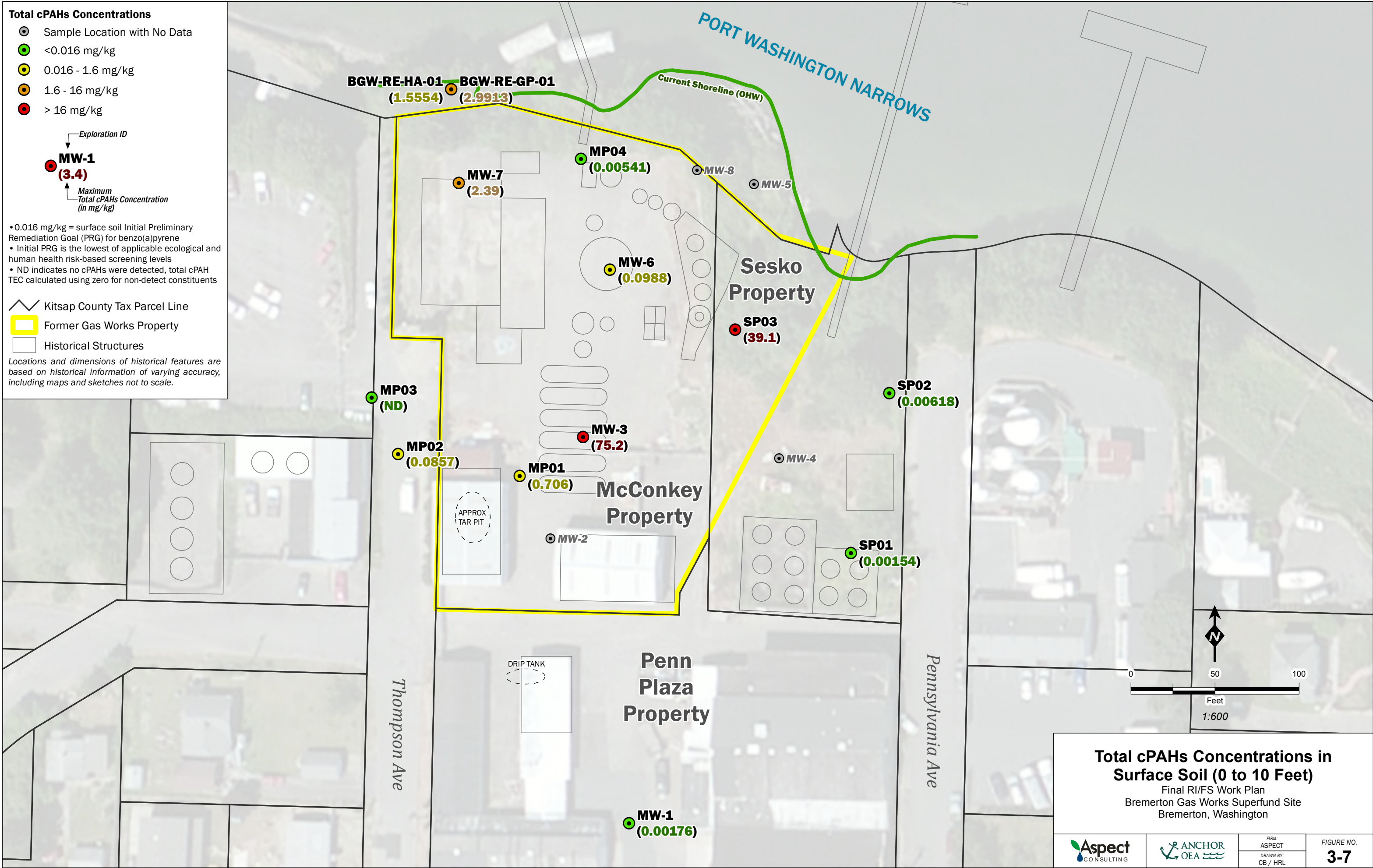
- 3.8 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)
- Initial PRG is the lowest of applicable human health risk-based screening levels
- Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

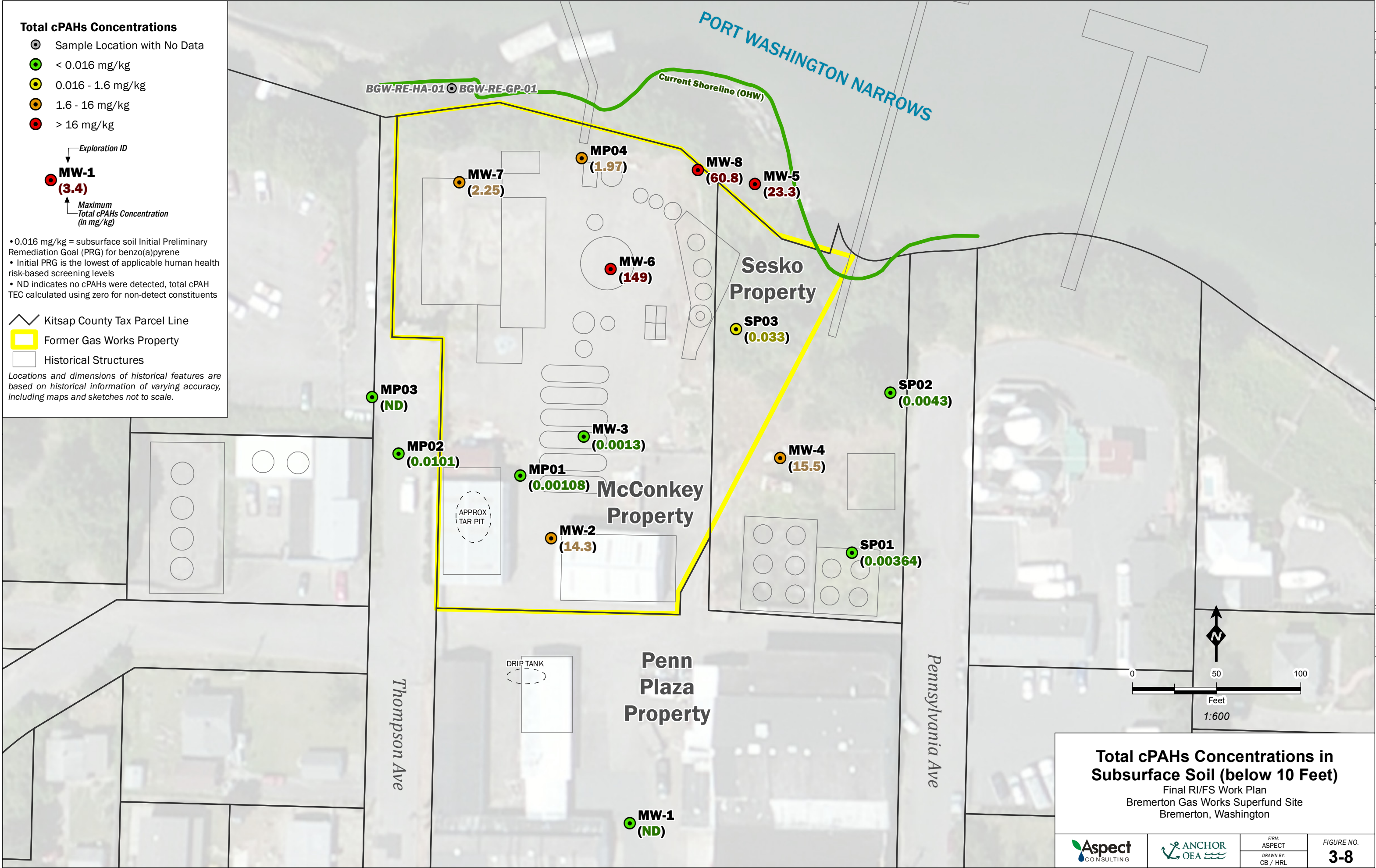
 Former Gas Works Property

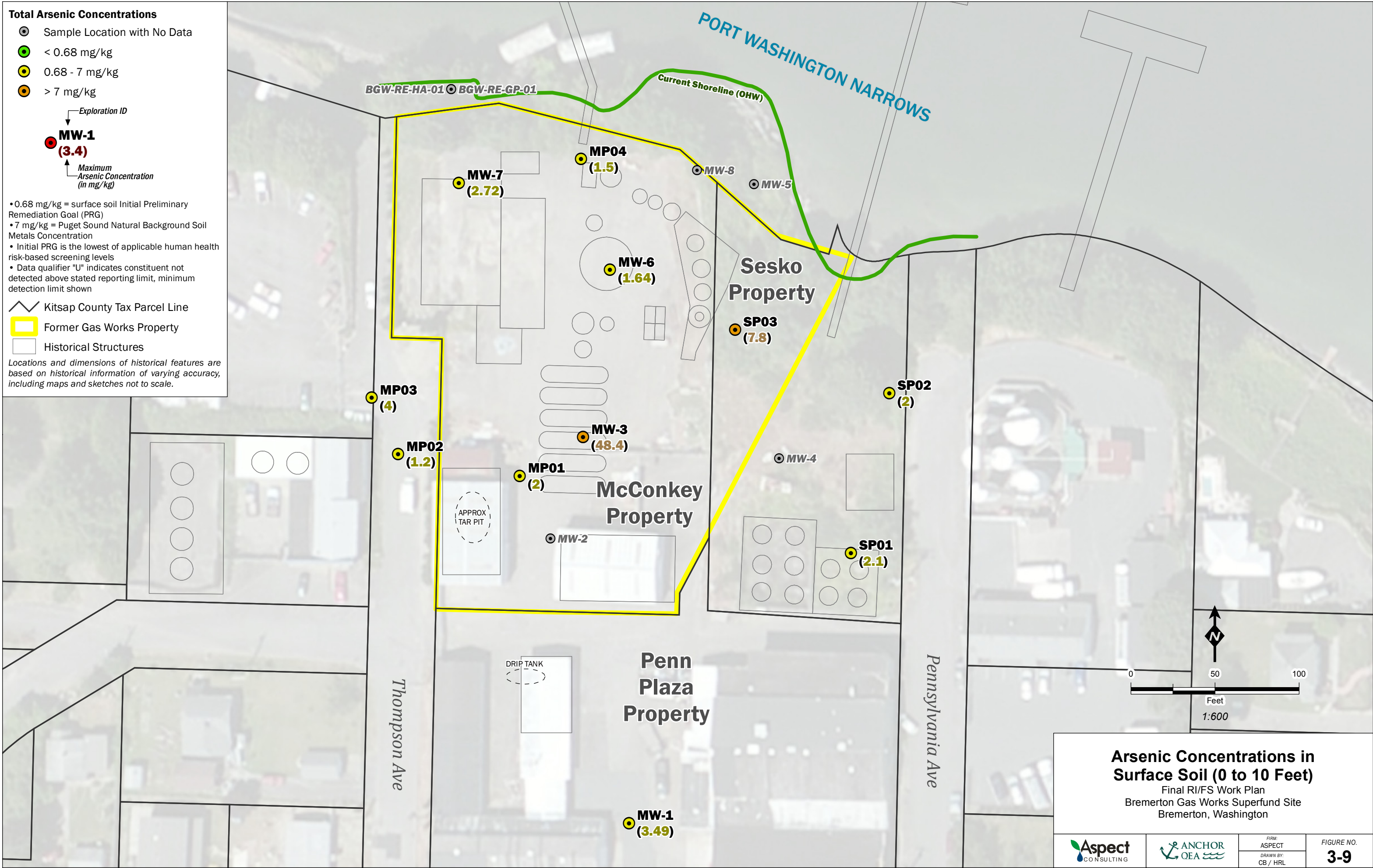
Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.









Total Arsenic Concentrations

Sample Location with No Data

< 0.68 mg/kg

0.68 - 7 mg/kg

> 7 mg/kg

Exploration ID

MW-1

(3.4)

Maximum Arsenic Concentration (in mg/kg)

• 0.68 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)

• 7 mg/kg = Puget Sound Natural Background Soil Metals Concentration

• Initial PRG is the lowest of applicable human health risk-based screening levels

• Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

Kitsap County Tax Parcel Line

Former Gas Works Property

Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Legend:

- Total Arsenic Concentrations:**
 - Sample Location with No Data
 - < 0.68 mg/kg
 - 0.68 - 7 mg/kg
 - > 7 mg/kg
- Exploration ID:** MW-1 (3.4)
- Maximum Arsenic Concentration (in mg/kg):** (3.4)
- 0.68 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)
- 7 mg/kg = Puget Sound Natural Background Soil Metals Concentration
- Initial PRG is the lowest of applicable human health risk-based screening levels
- Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown
- Kitsap County Tax Parcel Line
- Former Gas Works Property
- Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Map Labels:

- PORT WASHINGTON NARROWS
- Current Shoreline (OHV)
- BGW-RE-HA-01
- BGW-RE-GP-01
- MW-7 (1.01)
- MP04 (3.6)
- MW-8 (6.72)
- MW-5 (3.81)
- Sesko Property
- SP03 (4.6)
- MP03 (1)
- MP02 (0.8)
- MW-3 (1.27)
- MP01 (3.2)
- McConkey Property
- MW-2 (3.18)
- MW-4 (4.8)
- SP01 (1.8)
- Penn Plaza Property
- MW-1 (1.35)
- Thompson Ave
- Pennsylvania Ave
- DRIP TANK
- APPROX TAR PIT

Scale: 0, 50, 100 Feet
1:600

North Arrow: N

Title Block:

Arsenic Concentrations in Subsurface Soil (Below 10 ft)
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Logos: Aspect CONSULTING, ANCHOR OEA

Metadata:

FIRM: ASPECT	FIGURE NO. 3-10
DRAWN BY: CB / HRL	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: 1\Projects_8\Bremerton_MGP\Deliverables\Final RI/FS Work Plan\3-10 Arsenic subsurf soil.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/20/2017 || User: mepin || Print Date: 1/20/2017

Total Copper Concentrations

Sample Location with No Data

< 28 mg/kg

28 - 36 mg/kg

> 36 mg/kg

Exploration ID

MW-1

(3.4)

Maximum Copper Concentration (in mg/kg)

• 28 mg/kg = surface soil Initial Preliminary Remediation Goal (PRG)

• 36 mg/kg = Puget Sound Natural Background Soil Metals Concentration

• Initial PRG is the lowest of applicable ecological and human health risk-based screening levels

• Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

Kitsap County Tax Parcel Line

Former Gas Works Property

Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Copper Concentrations in Surface Soil (0 to 10 Feet)
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

ASPECT CONSULTING **ANCHOR OEA**

FIRM: ASPECT
DRAWN BY: HRL / CB

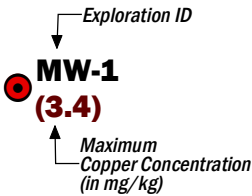
FIGURE NO. **3-11**

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: I:\Projects_8\Bremerton_MGP\Deliverables\Final RI/FS Work Plan\3-11 Copper Surface Soil.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/20/2017 || User: mepin || Print Date: 1/20/2017

Total Copper Concentrations

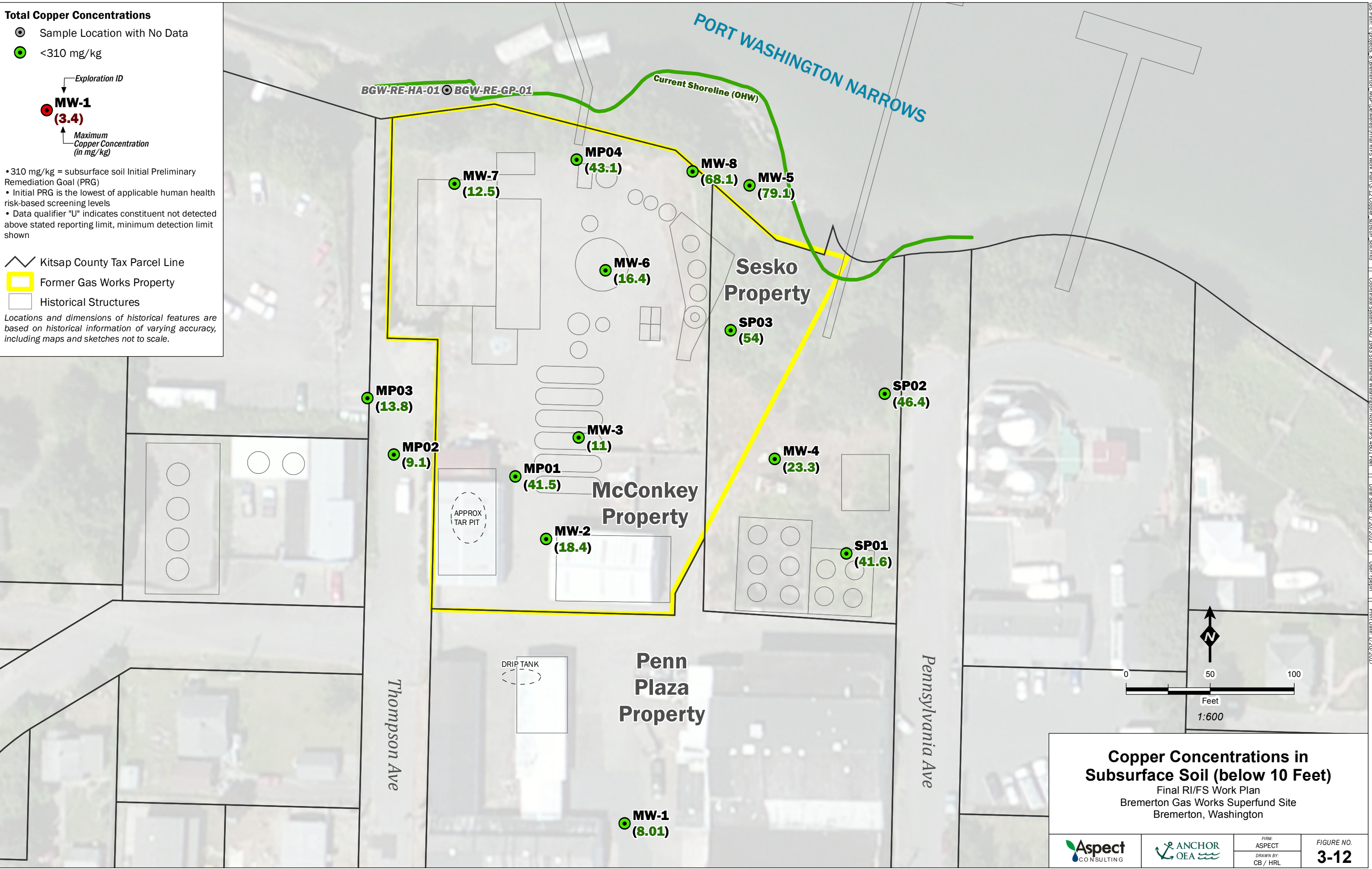
- Sample Location with No Data
- <310 mg/kg

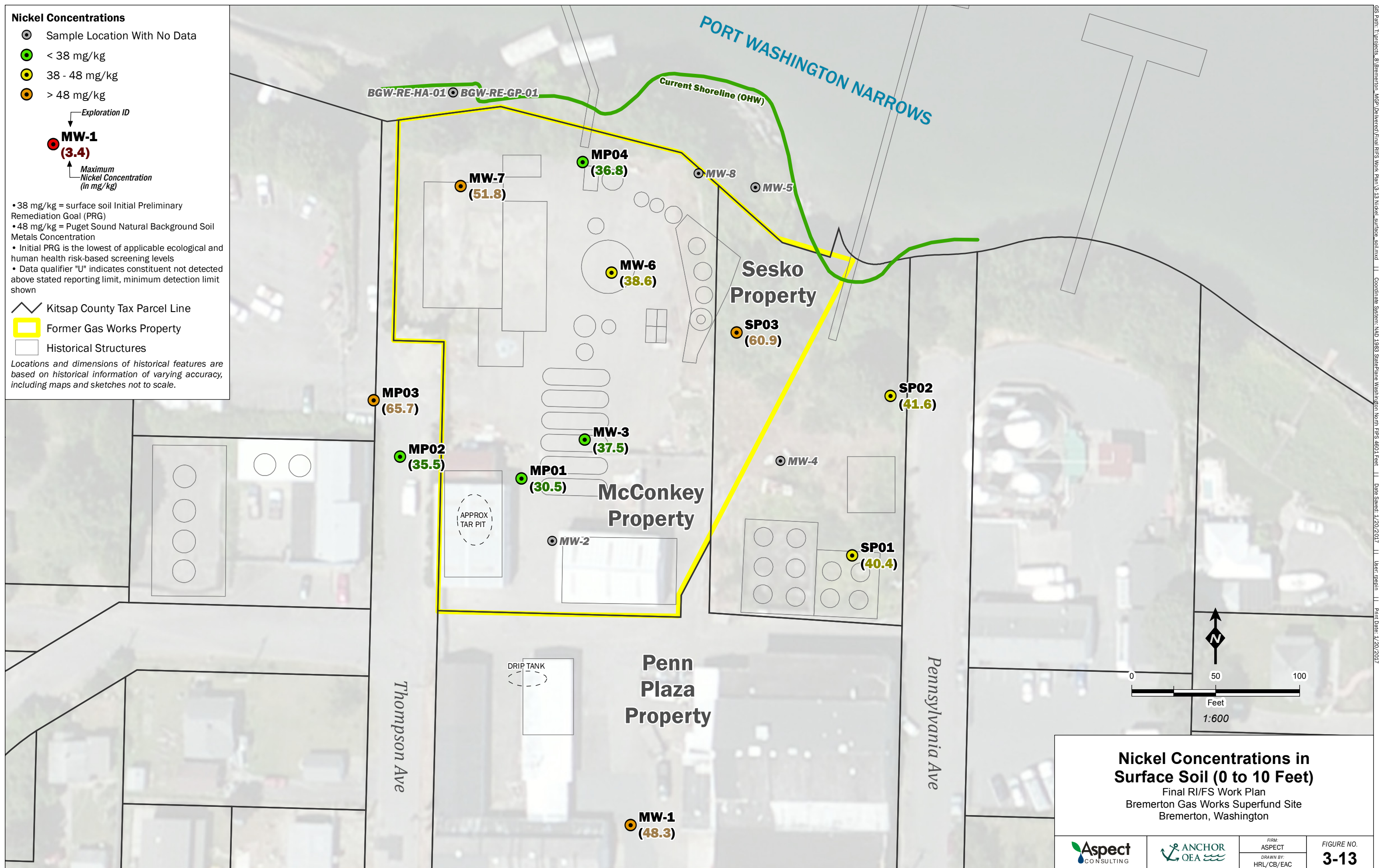


- 310 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)
- Initial PRG is the lowest of applicable human health risk-based screening levels
- Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

- ▬ Kitsap County Tax Parcel Line
- ▭ Former Gas Works Property
- ▭ Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.





Total Nickel Concentrations

Sample Location with No Data

< 150 mg/kg

Exploration ID

MW-1

(3.4)

Maximum Nickel Concentration (in mg/kg)

• 150 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)

• Initial PRG is the lowest of applicable human health risk-based screening levels

• Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

Kitsap County Tax Parcel Line

Former Gas Works Property

Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

Nickel Concentrations in Subsurface Soil (Below 10 Feet)
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Legend:

- Sample Location with No Data
- < 150 mg/kg
- Exploration ID
- Maximum Nickel Concentration (in mg/kg)
- 150 mg/kg = subsurface soil Initial Preliminary Remediation Goal (PRG)
- Initial PRG is the lowest of applicable human health risk-based screening levels
- Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown
- Kitsap County Tax Parcel Line
- Former Gas Works Property
- Historical Structures

Map Labels:

- PORT WASHINGTON NARROWS
- Current Shoreline (OHV)
- BGW-RE-HA-01
- BGW-RE-GP-01
- MW-1 (3.4)
- MW-7 (43.3)
- MP04 (66.3)
- MW-8 (42.1)
- MW-5 (61.1)
- MW-6 (33.3)
- SP03 (65.3)
- Sesko Property
- SP02 (57.8)
- MW-4 (44.6)
- SP01 (58.2)
- McConkey Property
- MP03 (35)
- MP02 (32.8)
- MW-3 (36.2)
- MP01 (54)
- MW-2 (40.6)
- Penn Plaza Property
- MW-1 (32.5)
- Thompson Ave
- Pennsylvania Ave
- DRIP TANK
- APPROX TAR PIT

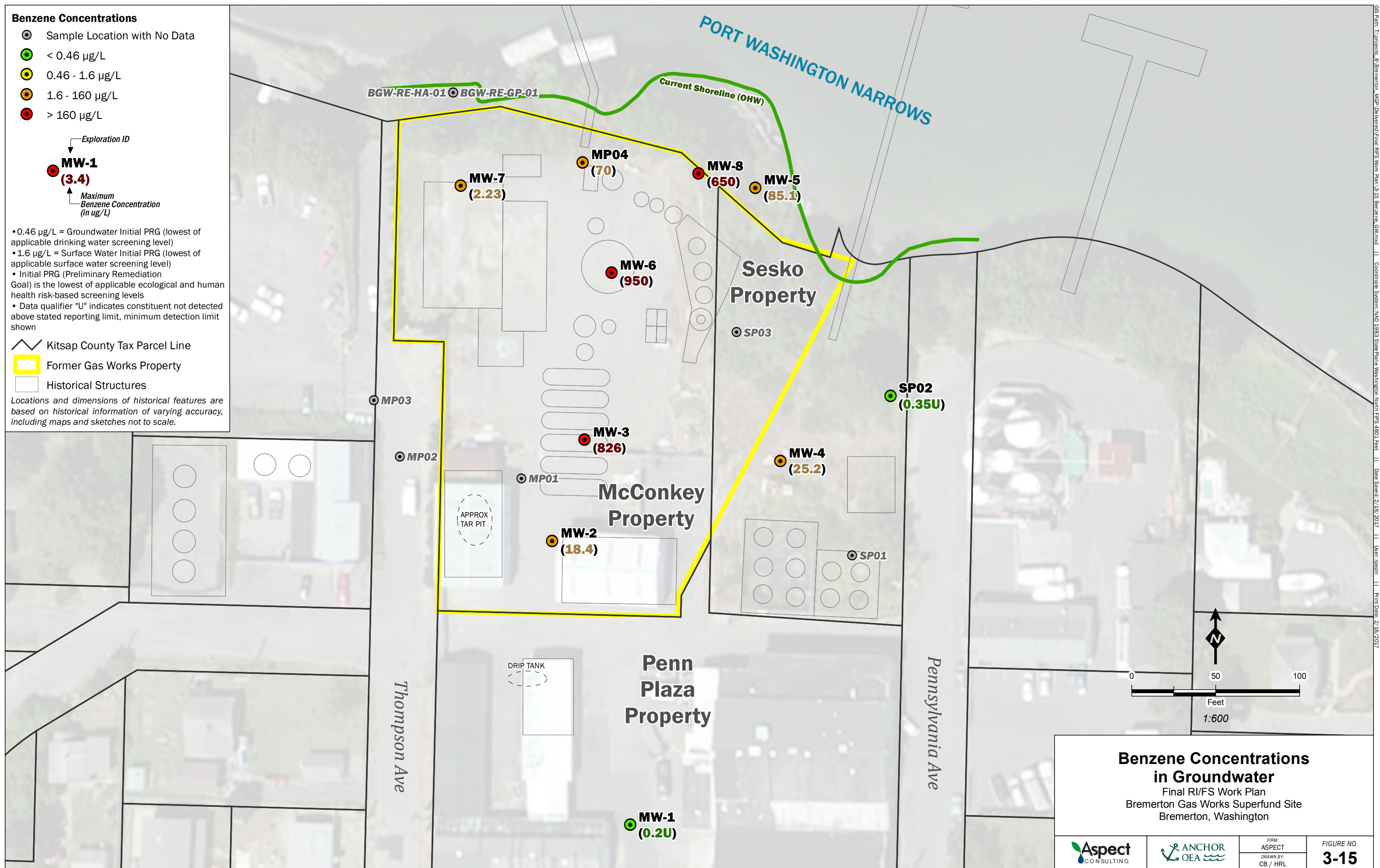
Scale: 0, 50, 100 Feet
1:600

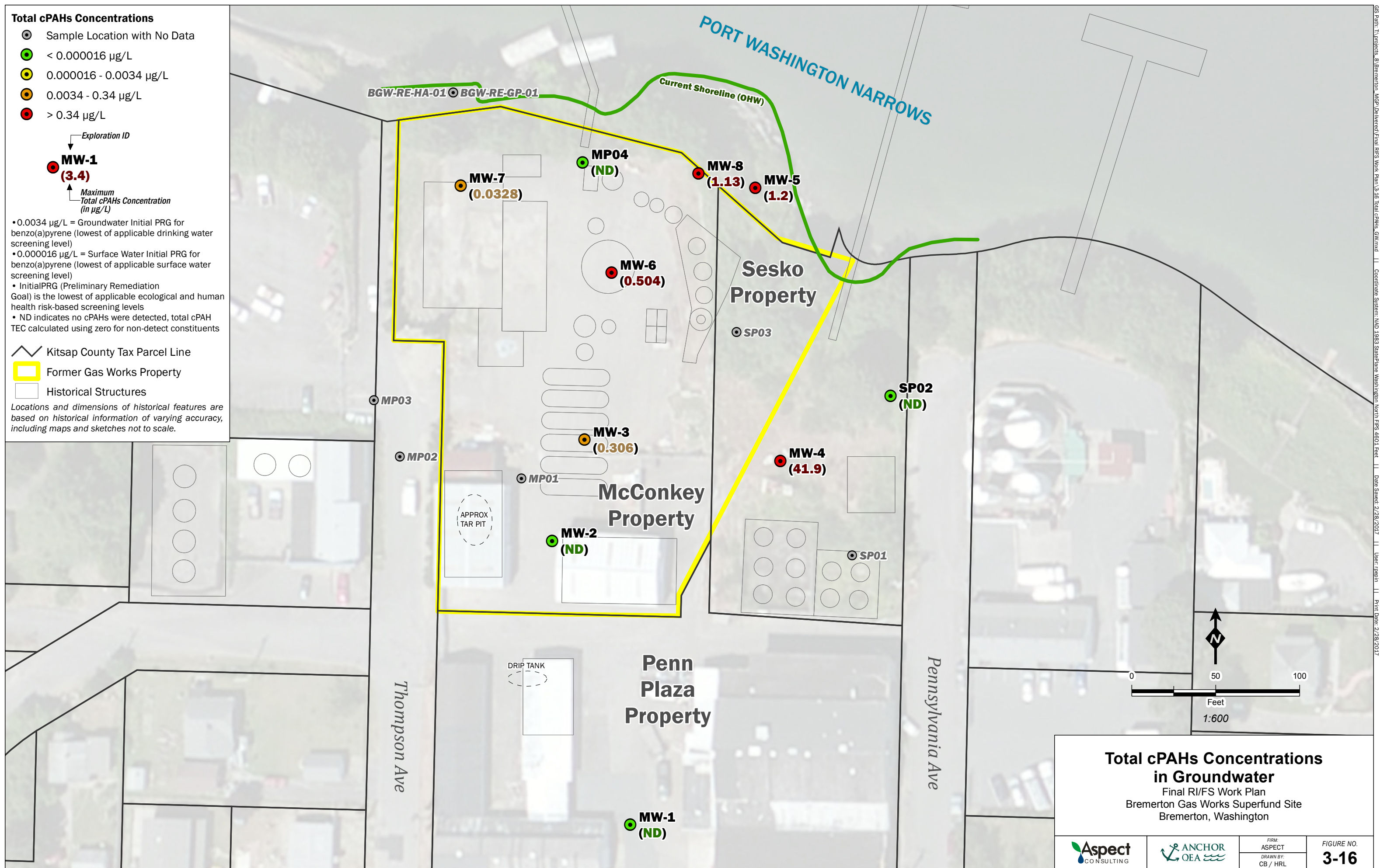
Logos: Aspect CONSULTING, ANCHOR OEA

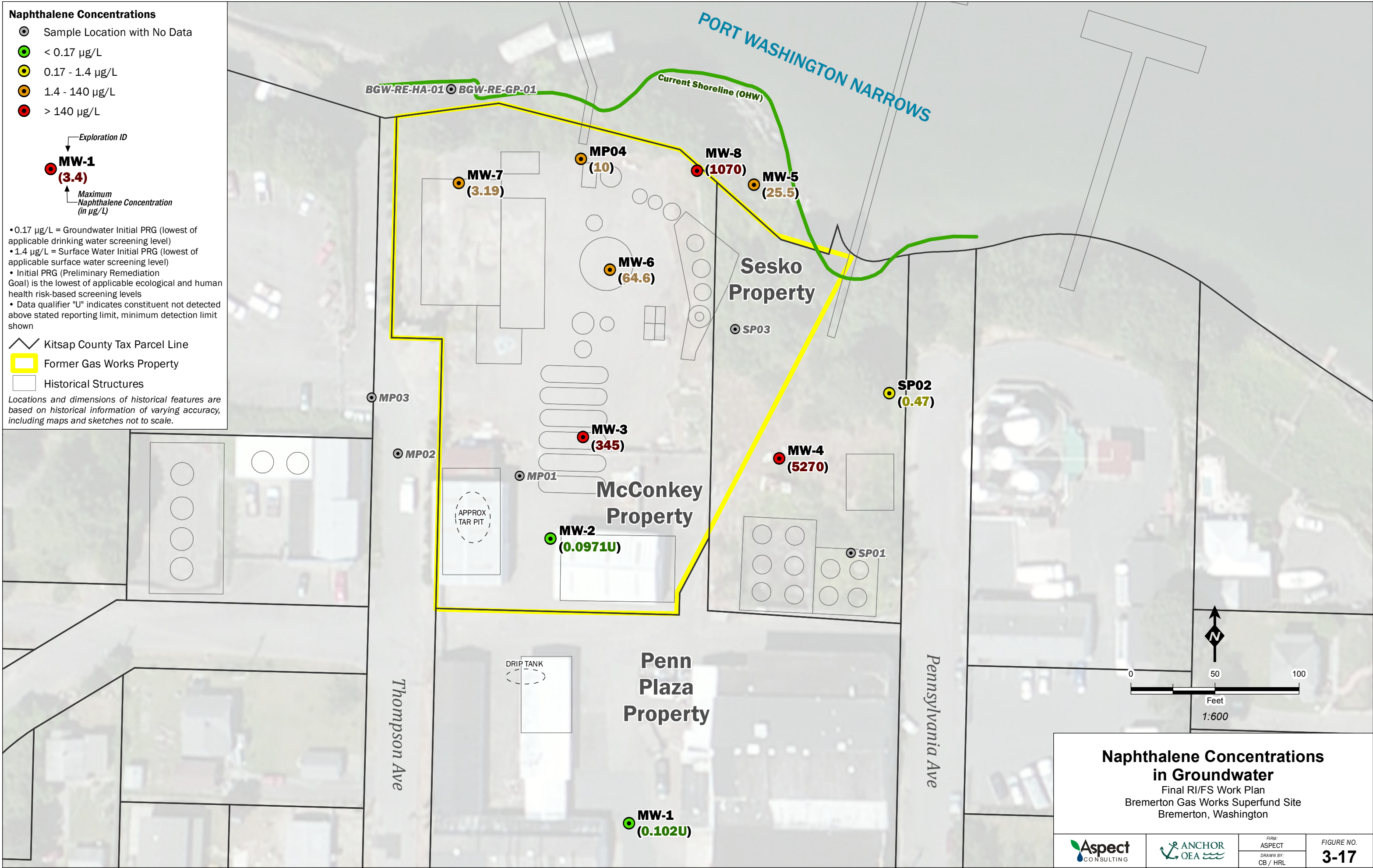
Metadata:
FIRM: ASPECT
DRAWN BY: CB/HRL/EAC
FIGURE NO. 3-14

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: I:\Projects_8\Bremerton_MGP\Deliverables\Final RI/FS Work Plan\3-14 Nickel subsurf soil.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/20/2017 || User: jrapin || Print Date: 1/20/2017







●

Sample Location with No Data

●

< 0.052 ug/L

●

0.052 - 0.14 ug/L

●

0.14 - 14 ug/L

●

> 14 ug/L

Exploration ID

MW-1

(3.4)

Maximum Arsenic Concentration (in ug/L)

• 0.052 ug/L = Groundwater Initial PRG (lowest of applicable drinking water screening level)

• 0.14 ug/L = Surface Water Initial PRG (lowest of applicable surface water screening level)

• Initial PRG (Preliminary Remediation Goal) is the lowest of applicable ecological and human health risk-based screening levels

• Data qualifier "U" indicates constituent not detected above stated reporting limit, minimum detection limit shown

Kitsap County Tax Parcel Line

Former Gas Works Property

Historical Structures

Locations and dimensions of historical features are based on historical information of varying accuracy, including maps and sketches not to scale.

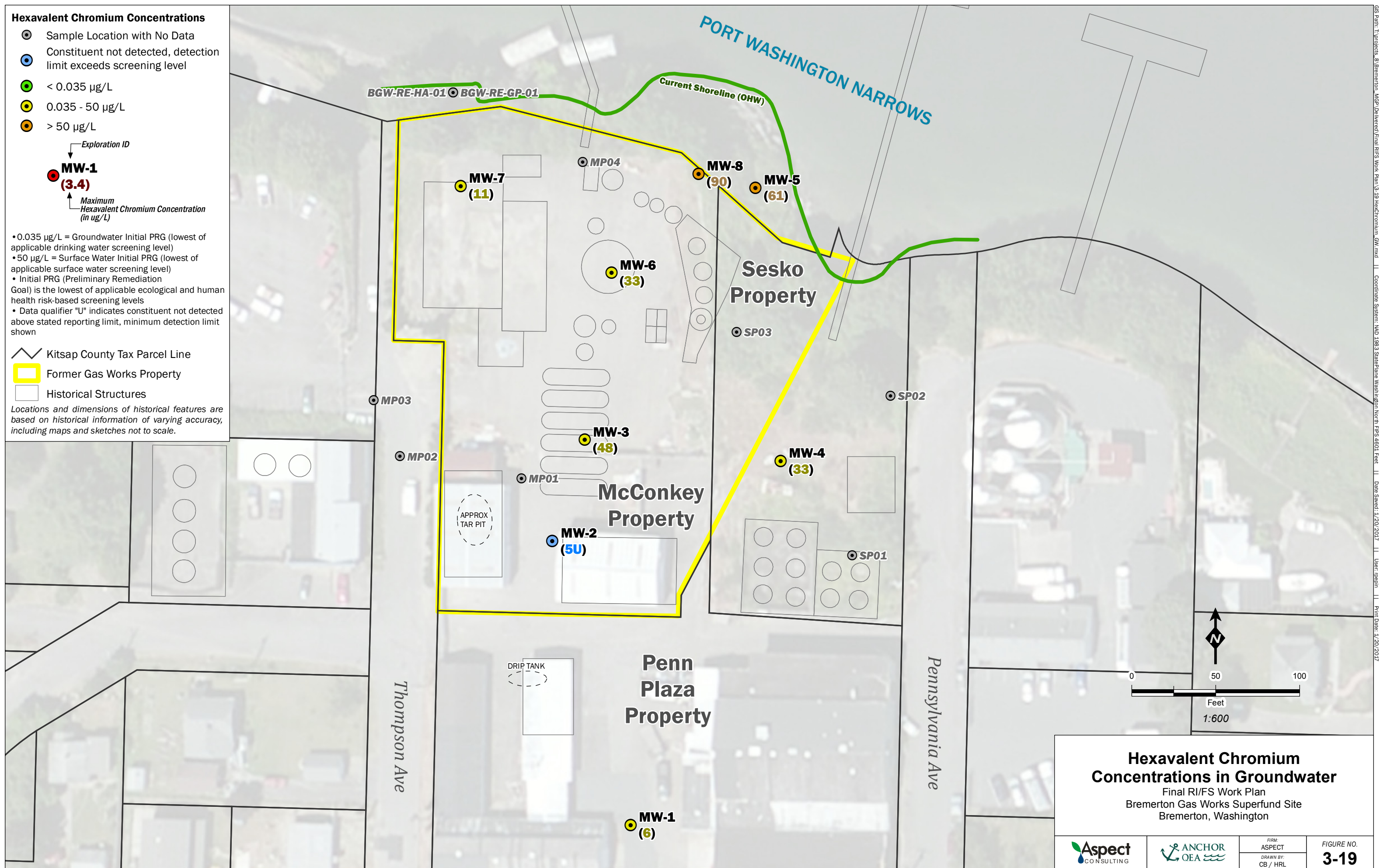
Arsenic Concentrations in Groundwater
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

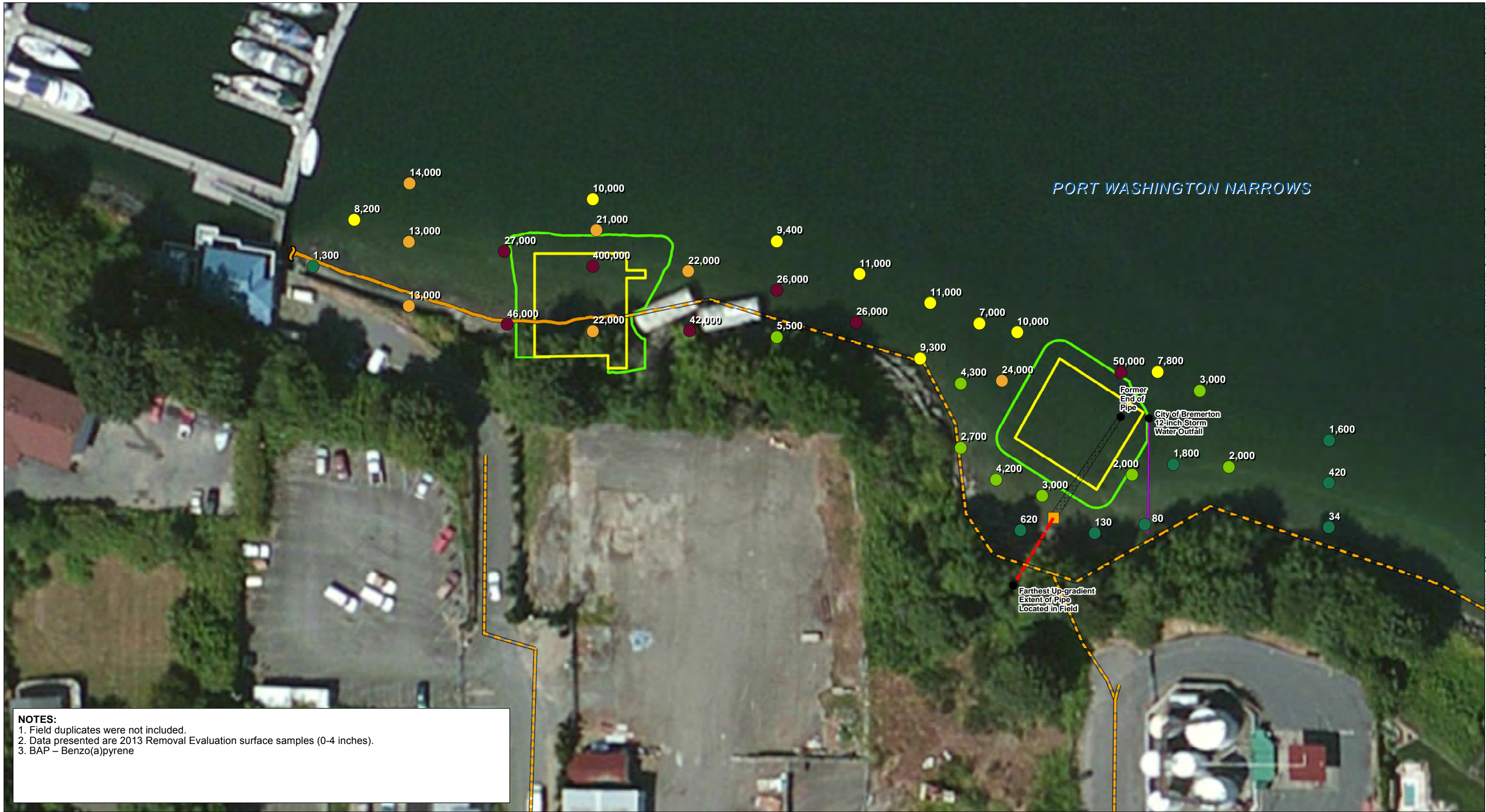
Aspect CONSULTING | ANCHOR OEA | FIRM: ASPECT | DRAWN BY: CB/HRL/EAC | FIGURE NO. 3-18

Monitoring Point	Exploration ID	Maximum Arsenic Concentration (in ug/L)
MW-1		3.4
MW-2		1.08
MW-3		14.2
MW-4		26
MW-5		2.83
MW-6		4.8
MW-7		1.43
MW-8		4.69
MP01		
MP02		
MP03		
MP04		4.1
SP01		
SP02		0.6
SP03		

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: I:\projects_8\Bremerton_MGP\Deliverables\Final RI/FS Work Plan\3-18 Arsenic_GW.mxd | Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet | Date Saved: 1/20/2017 | User: mjamin | Print Date: 1/20/2017

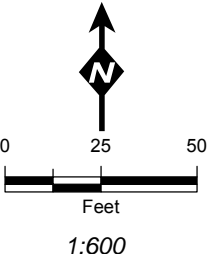




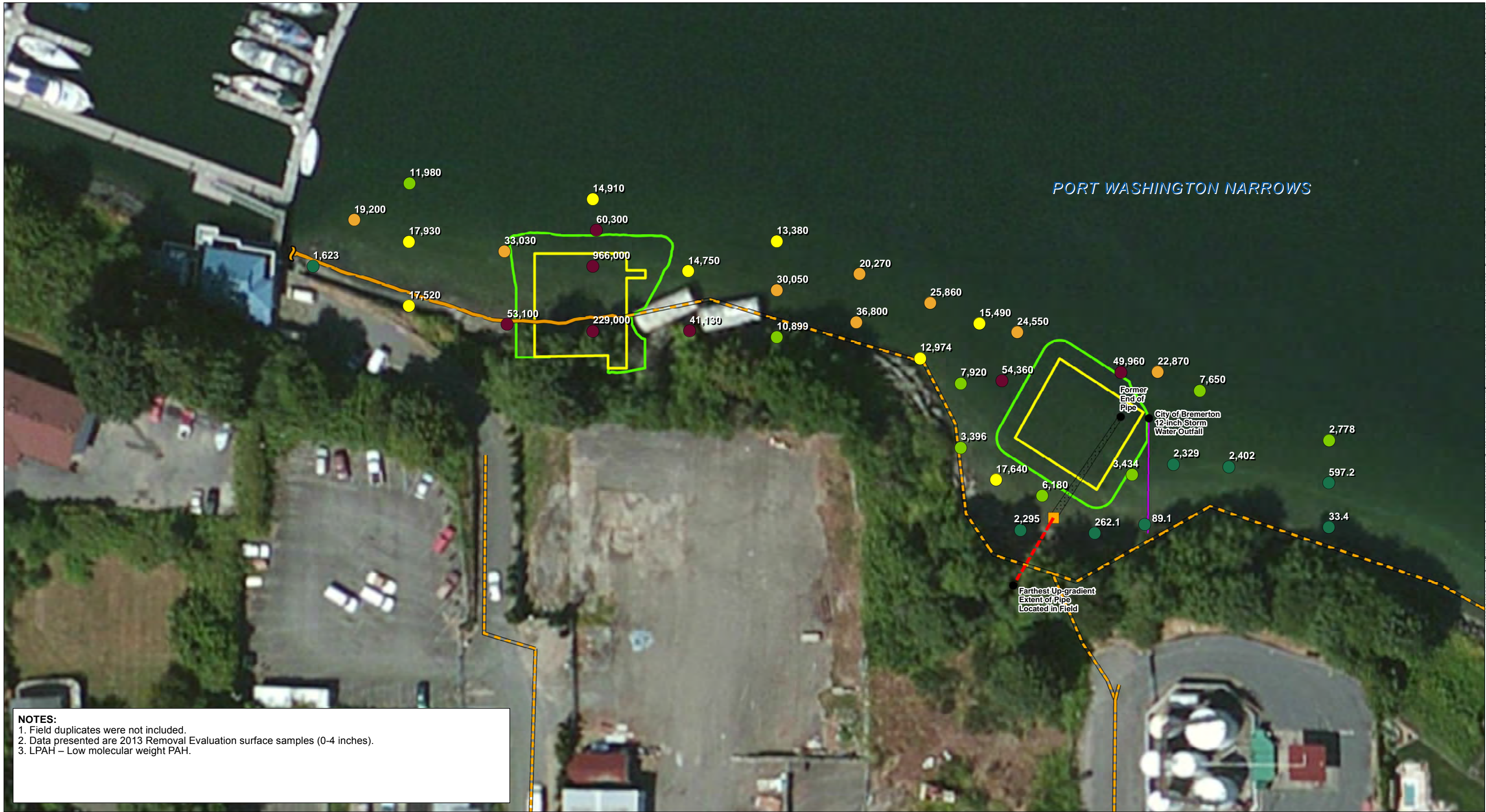
NOTES:
1. Field duplicates were not included.
2. Data presented are 2013 Removal Evaluation surface samples (0-4 inches).
3. BAP – Benzo(a)pyrene

- Benzo(a)pyrene µg/kg dw
- 34.0 - 1,800
 - 1,810 - 5,500
 - 5,510 - 11,000
 - 11,100 - 24,000
 - 24,100 - 400,000
- 2010 TCRA/IA Pipe Plug Location
 - Assumed City of Bremerton 12-inch Storm Water Pipe Configuration
 - Field-located Sanitary Sewer Line
 - Sanitary Sewer (Not Field Located)
 - Sewer Line Continues West from this Location

- Field Verified Pipe Location
- Remaining 12-inch Concrete Pipe
- Pipe Removed and Backfilled to Grade
- Cover of Existing Organoclay Mat (10-inch minus rock)
- Extent of Existing Organoclay Mat



Surface Sediment Benzo(a)pyrene Concentrations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



NOTES:

1. Field duplicates were not included.

2. Data presented are 2013 Removal Evaluation surface samples (0-4 inches).

3. LPAH – Low molecular weight PAH.

Total LPAH (SMS) (U = 0) µg/kg dw

- 33.4 - 2,400
- 2,410 - 12,000
- 12,100 - 17,900
- 18,000 - 36,800
- 36,900 - 966,000

- 2010 TCRA/IA Pipe Plug Location
- Assumed City of Bremerton 12-inch Storm Water Pipe Configuration
- Field-located Sanitary Sewer Line
- Sanitary Sewer (Not Field Located)
- Sewer Line Continues West from this Location

- Field Verified Pipe Location
- Remaining 12-inch Concrete Pipe
- Pipe Removed and Backfilled to Grade
- Cover of Existing Organoclay Mat (10-inch minus rock)
- Extent of Existing Organoclay Mat

0 25 50 Feet
1:600

N

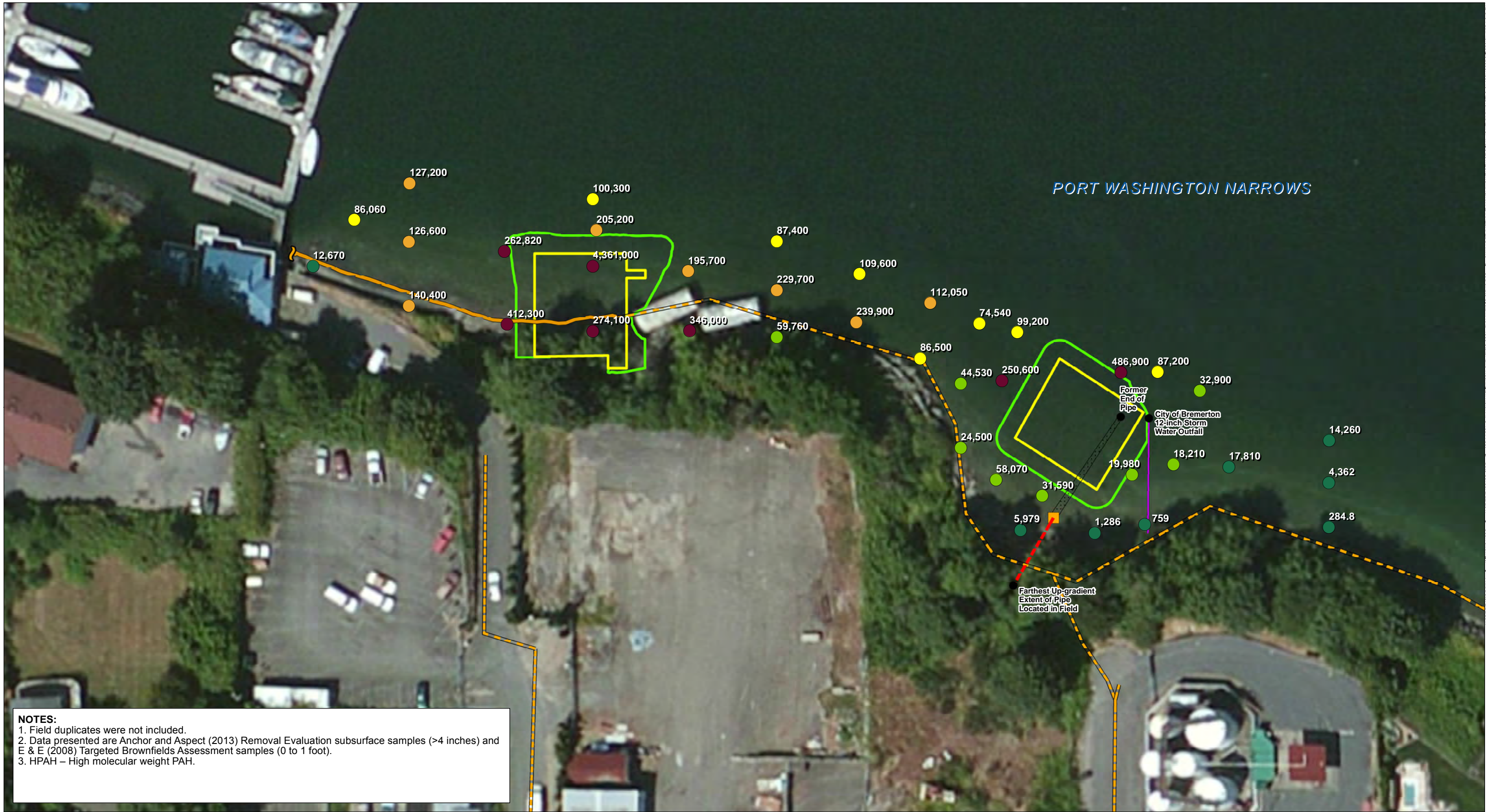
Surface Sediment LPAH Concentrations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Aspect CONSULTING

ANCHOR QEA

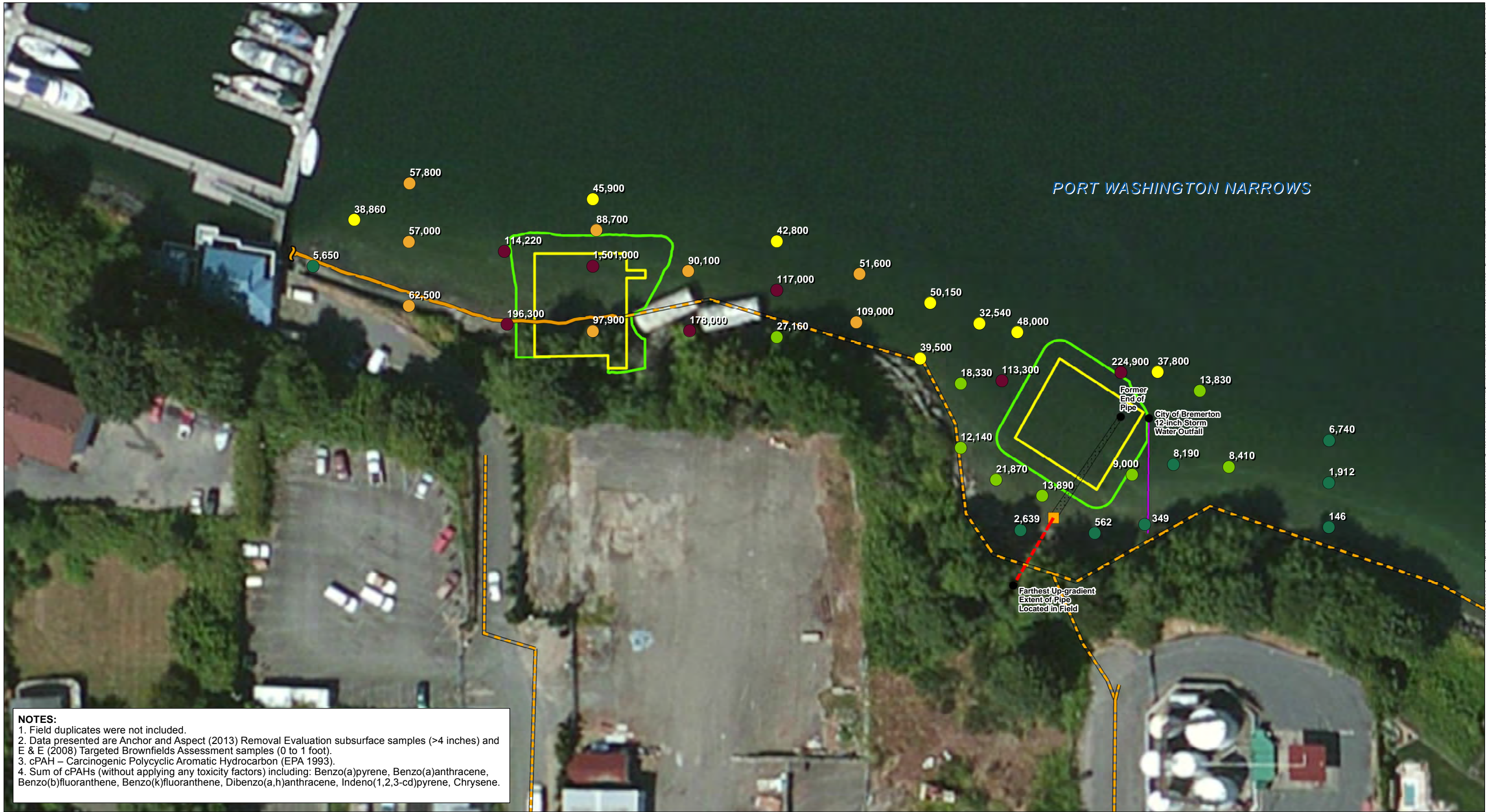
FIRM: ANCHOR QEA
DRAWN BY: ckiblinger

FIGURE NO. 3-21



NOTES:
1. Field duplicates were not included.
2. Data presented are Anchor and Aspect (2013) Removal Evaluation subsurface samples (>4 inches) and E & E (2008) Targeted Brownfields Assessment samples (0 to 1 foot).
3. HPAH – High molecular weight PAH.

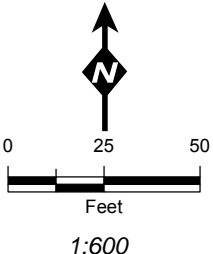
<p>Total HPAH (SMS) (U = 0) µg/kg dw</p> <ul style="list-style-type: none">285 - 17,80017,900 - 59,80059,900 - 110,000111,000 - 240,000241,000 - 4,360,000	<ul style="list-style-type: none">2010 TCRA/IA Pipe Plug LocationAssumed City of Bremerton 12-inch Storm Water Pipe ConfigurationField-located Sanitary Sewer LineSanitary Sewer (Not Field Located)Sewer Line Continues West from this Location	<ul style="list-style-type: none">Field Verified Pipe LocationRemaining 12-inch Concrete PipePipe Removed and Backfilled to GradeCover of Existing Organoclay Mat (10-inch minus rock)Extent of Existing Organoclay Mat	<div><div>02550</div><div>Feet</div><div>1:600</div></div> <div><div>North Arrow</div><div>N</div></div>	<p>Surface Sediment HPAH Concentrations Final RI/FS Work Plan Bremerton Gas Works Superfund Site Bremerton, Washington</p>	<div><div>AspectCONSULTING</div><div>ANCHOR QEA</div></div> <div><div>FIGURE NO.</div><div>3-22</div></div>
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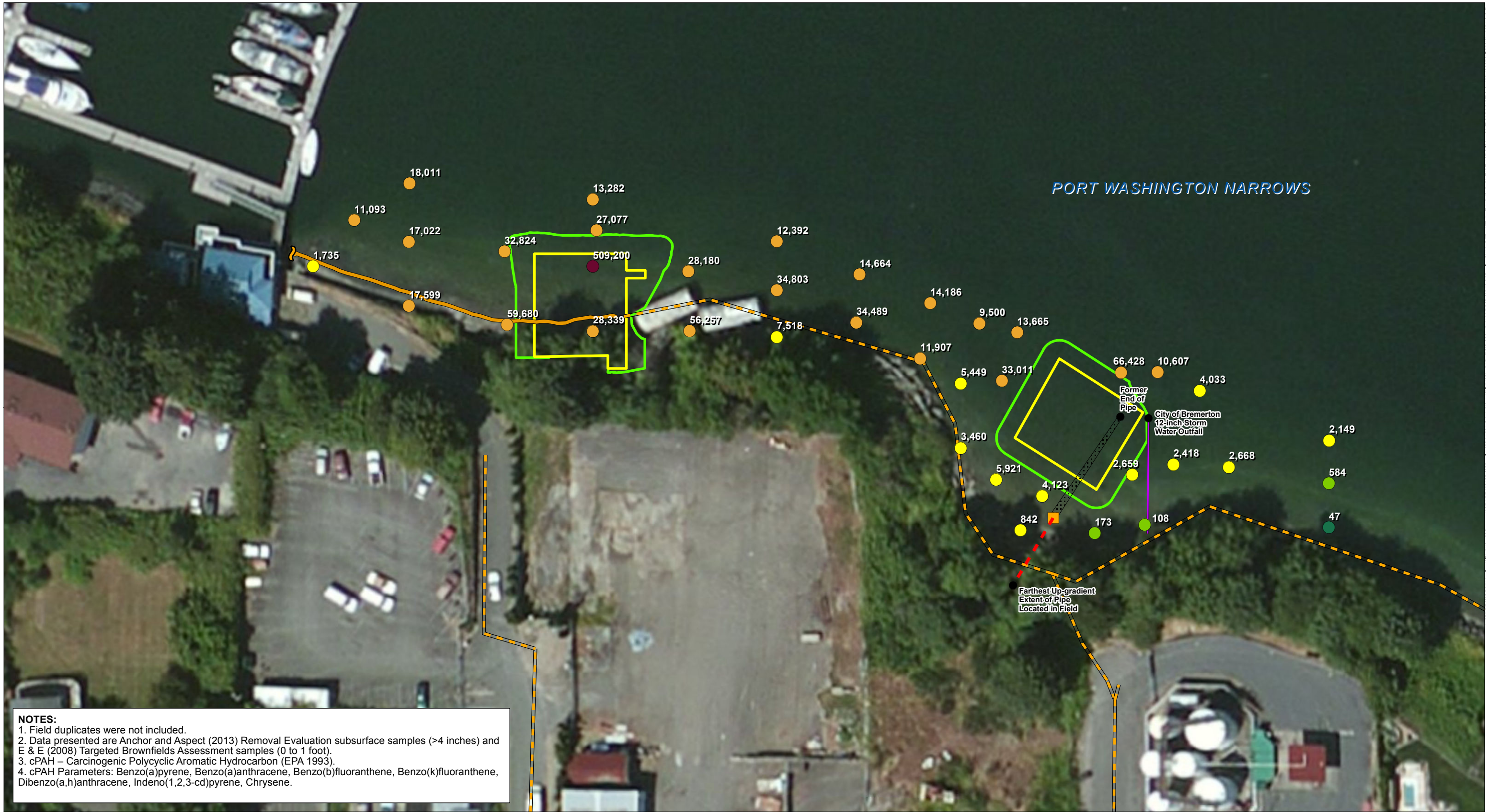
NOTES:
1. Field duplicates were not included.
2. Data presented are Anchor and Aspect (2013) Removal Evaluation subsurface samples (>4 inches) and E & E (2008) Targeted Brownfields Assessment samples (0 to 1 foot).
3. cPAH – Carcinogenic Polycyclic Aromatic Hydrocarbon (EPA 1993).
4. Sum of cPAHs (without applying any toxicity factors) including: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Chrysene.

- Total cPAH Sum (U = 1/2) µg/kg dw

 - 146 - 8,190
 - 8,191 - 27,160
 - 27,161 - 50,150
 - 50,151 - 109,000
 - 109,001 - 1,501,000
- 2010 TCRA/IA Pipe Plug Location
 - Assumed City of Bremerton 12-inch Storm Water Pipe Configuration
 - Field-located Sanitary Sewer Line
 - Sanitary Sewer (Not Field Located)
 - Sewer Line Continues West from this Location
- Field Verified Pipe Location
 - Remaining 12-inch Concrete Pipe
 - Pipe Removed and Backfilled to Grade
 - Cover of Existing Organoclay Mat (10-inch minus rock)
 - Extent of Existing Organoclay Mat

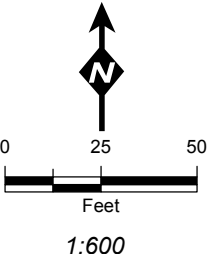


Surface Sediment Sum of cPAH Concentrations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

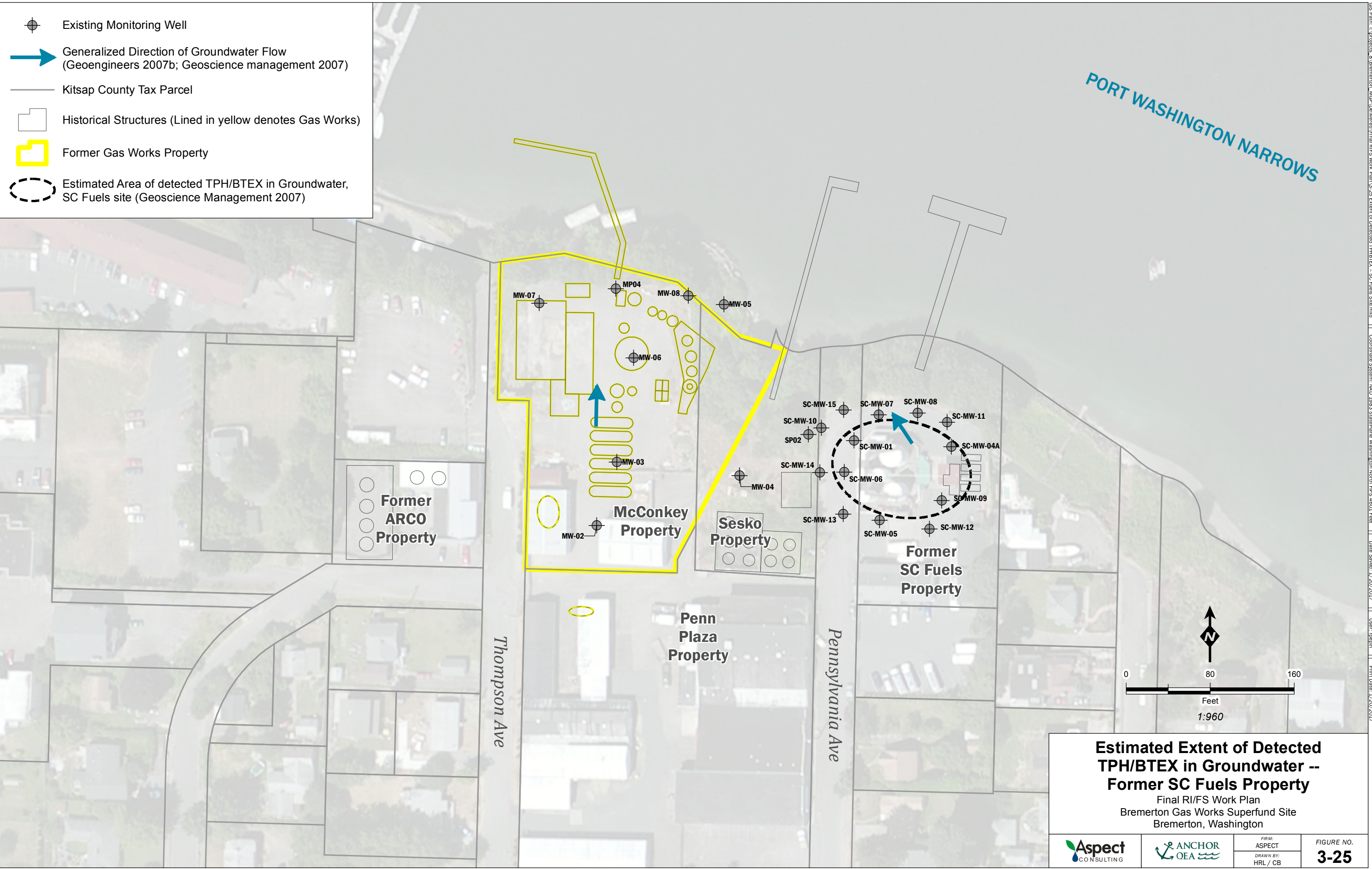


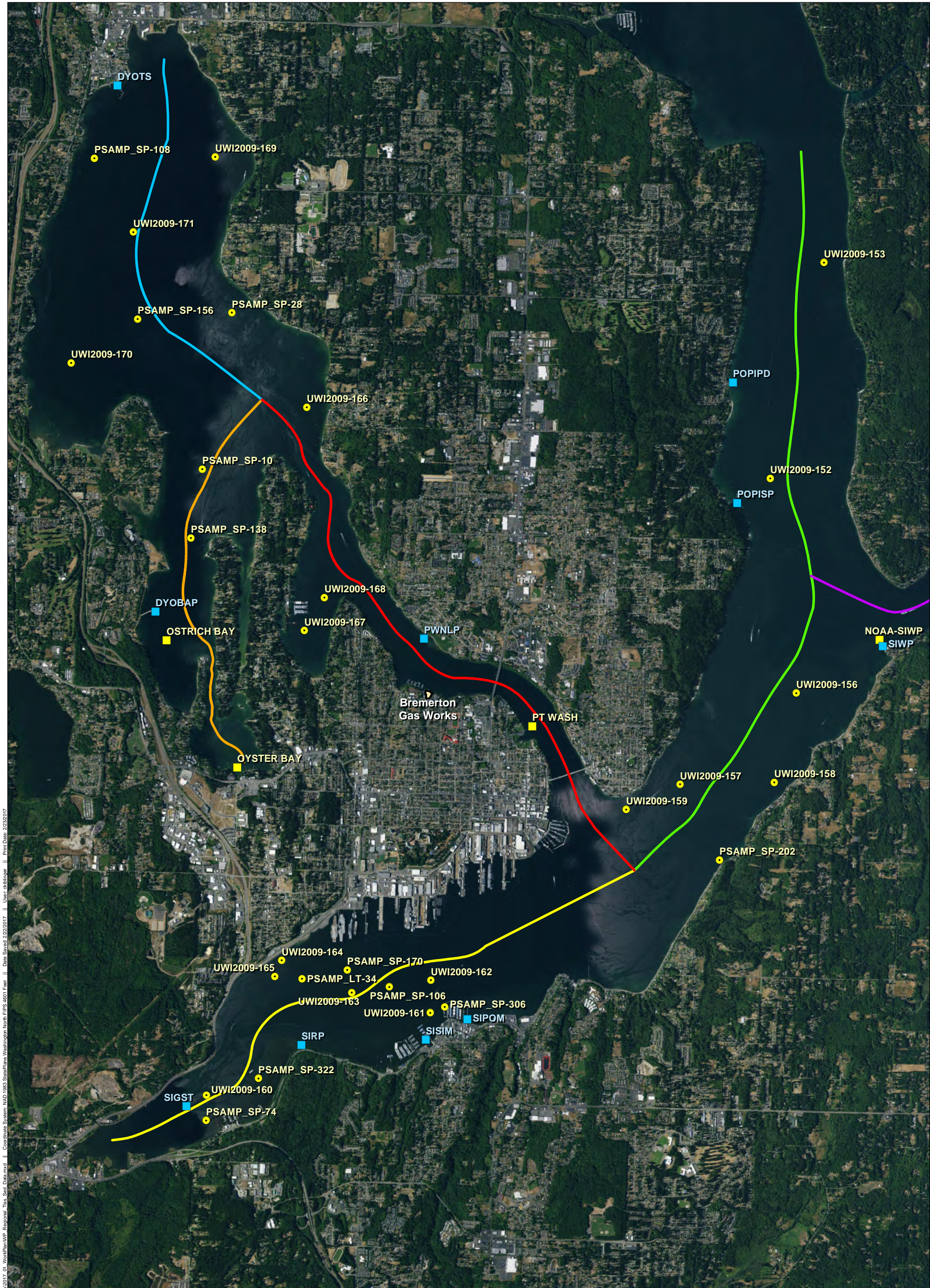
NOTES:
1. Field duplicates were not included.
2. Data presented are Anchor and Aspect (2013) Removal Evaluation subsurface samples (>4 inches) and E & E (2008) Targeted Brownfields Assessment samples (0 to 1 foot).
3. cPAH – Carcinogenic Polycyclic Aromatic Hydrocarbon (EPA 1993).
4. cPAH Parameters: Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Chrysene.

- | | | |
|--|--|---|
| Total cPAH TEQ (U = 1/2) $\mu\text{g/kg dw}$ | 2010 TCRA/IA Pipe Plug Location | Field Verified Pipe Location |
| 0 - 80 | Assumed City of Bremerton 12-inch Storm Water Pipe Configuration | Remaining 12-inch Concrete Pipe |
| 81 - 800 | Field-located Sanitary Sewer Line | Pipe Removed and Backfilled to Grade |
| 801 - 8,000 | Sanitary Sewer (Not Field Located) | Cover of Existing Organoclay Mat (10-inch minus rock) |
| 8,001 - 80,000 | Sewer Line Continues West from this Location | Extent of Existing Organoclay Mat |
| > 80,000 | | |



Surface Sediment cPAH TEQ Concentrations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington





AG GIS Path: \\nasgis\gis\hob\100719-01_Bremerton_MGP\Map\2017_01_WoodPan\WP_Regional_Tis_Sed_Data.mxd | Coordinates System: NAD 1983 StatePlane Washington North FIPS 4601 Feet | Date Saved: 2/22/2017 | User: cklbinger | Print Date: 2/23/2017

ENVVEST Stations

■ Tissue

EIM Stations

● Sediment

■ Tissue

— Dyes Inlet

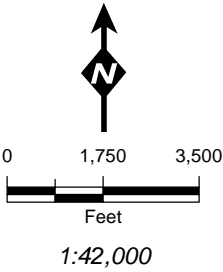
— Ostrich Bay

— Port Orchard

— Port Washington Narrows

— Rich Passage

— Sinclair Inlet

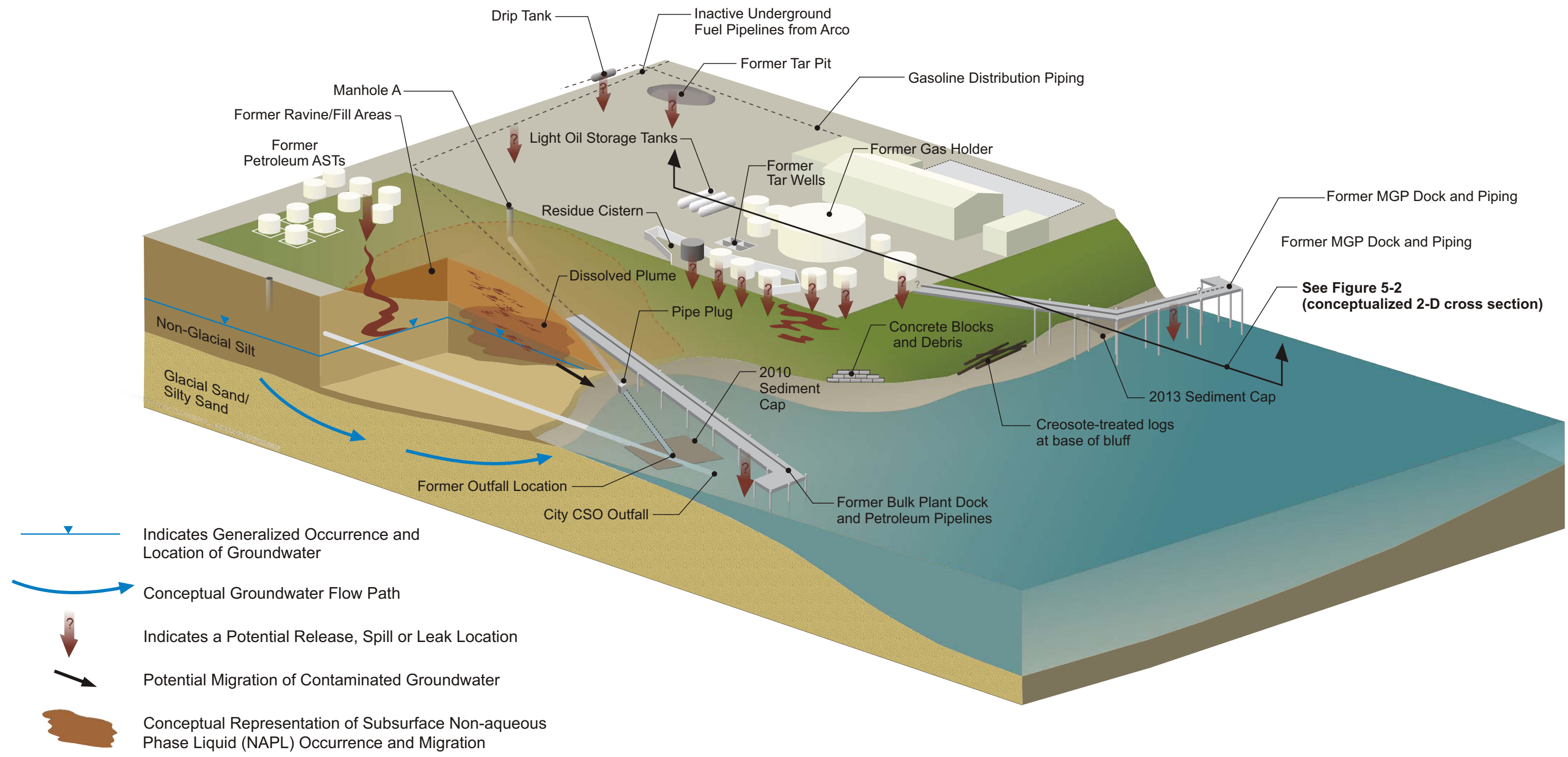


Locations of Regional Tissue and Sediment Data
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



FIRM:
ANCHOR QEA
DRAWN BY:
cklbinger

FIGURE NO.
3-26



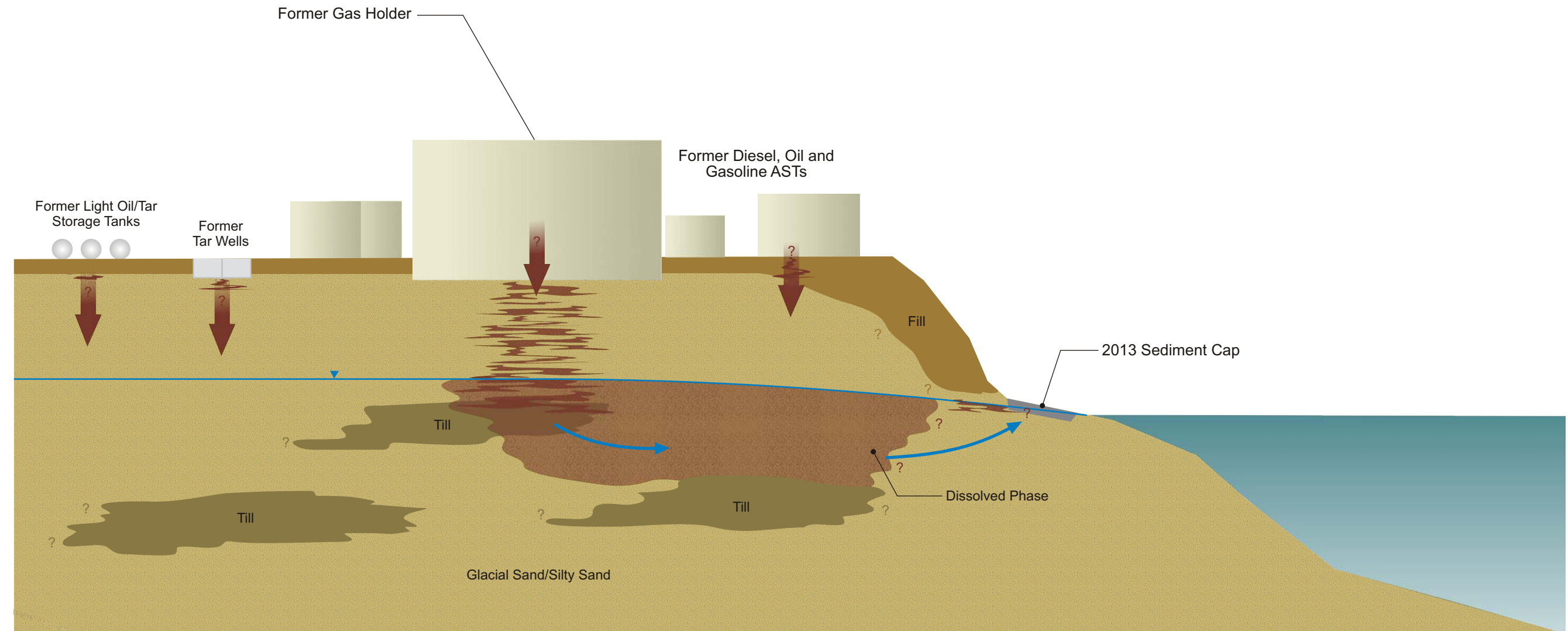
Note: Not to Scale

Preliminary Conceptual Site Model Final RI/FS Work Plan Bremerton Gas Works Superfund Site Bremerton, Washington



FIRM:
ASPECT
DRAWN BY:
CB / RAA

FIGURE NO.
4-1



Note: Not to Scale

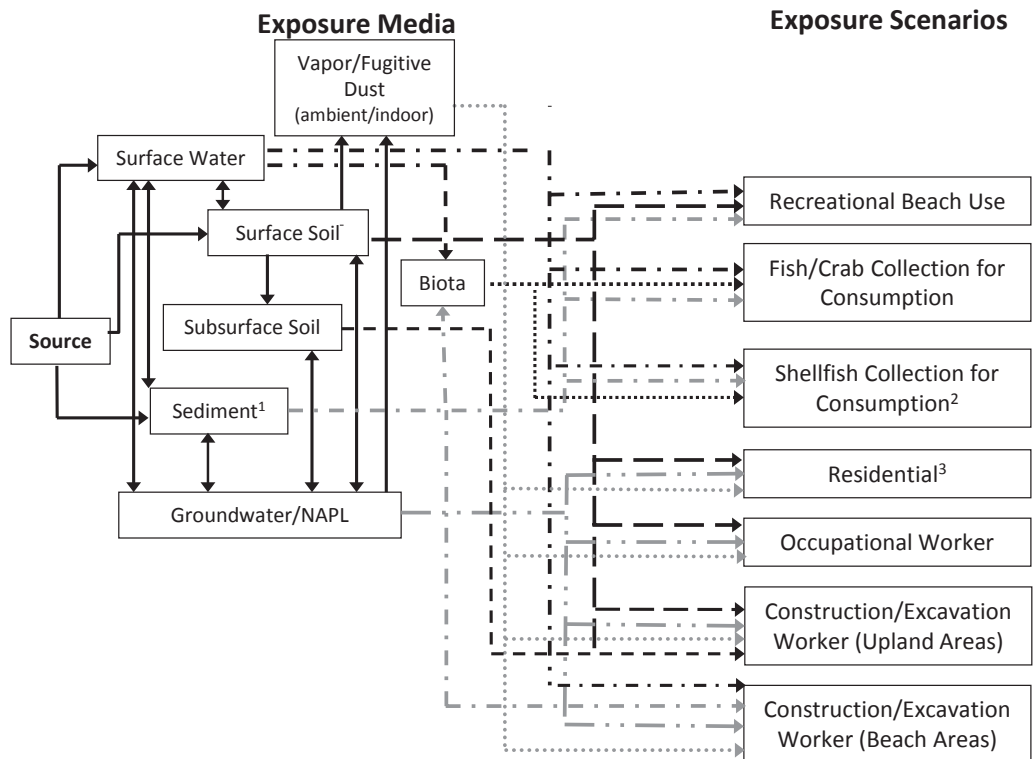
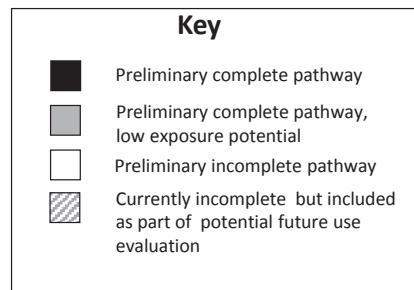
Conceptualized CSM Cross Section

Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



FIRM:
ASPECT
DRAWN BY:
CB / RAA

FIGURE NO.
4-2



Exposure Pathways

Derma Surface Soil Contact	Derma Subsurface Soil Contact	Derma Sediment Contact	Incidental Surface Soil Ingestion	Incidental Subsurface Soil Ingestion	Incidental Sediment Ingestion	Derma Water Contact	Incidental Surface Water Ingestion	Drinking Water Ingestion	Fish/Shellfish Ingestion	Inhalation (Fugitive Dust and Vapors)

Notes:

- Includes sediment porewater
- The portions of Port Washington Narrows adjacent to the Gas Works are currently listed as closed to shellfish harvesting (due to water quality concerns associated with combined sewer overflows and issues not related to the site) by the Washington Department of Health; however, exposures associated with shellfish harvesting will be evaluated to understand potential risks should shellfish harvest restrictions be lifted in the future.
- The Gas Works property and the adjacent properties are zoned and used for industrial uses; however, residential property exposures will be evaluated to understand potential implications should property uses be converted to residential at some point in the future.
- No water supply wells are located on or near the former Gas Works; however, groundwater ingestion is retained for screening pending further evaluation of groundwater beneficial uses.

Human Health Conceptual Site Model

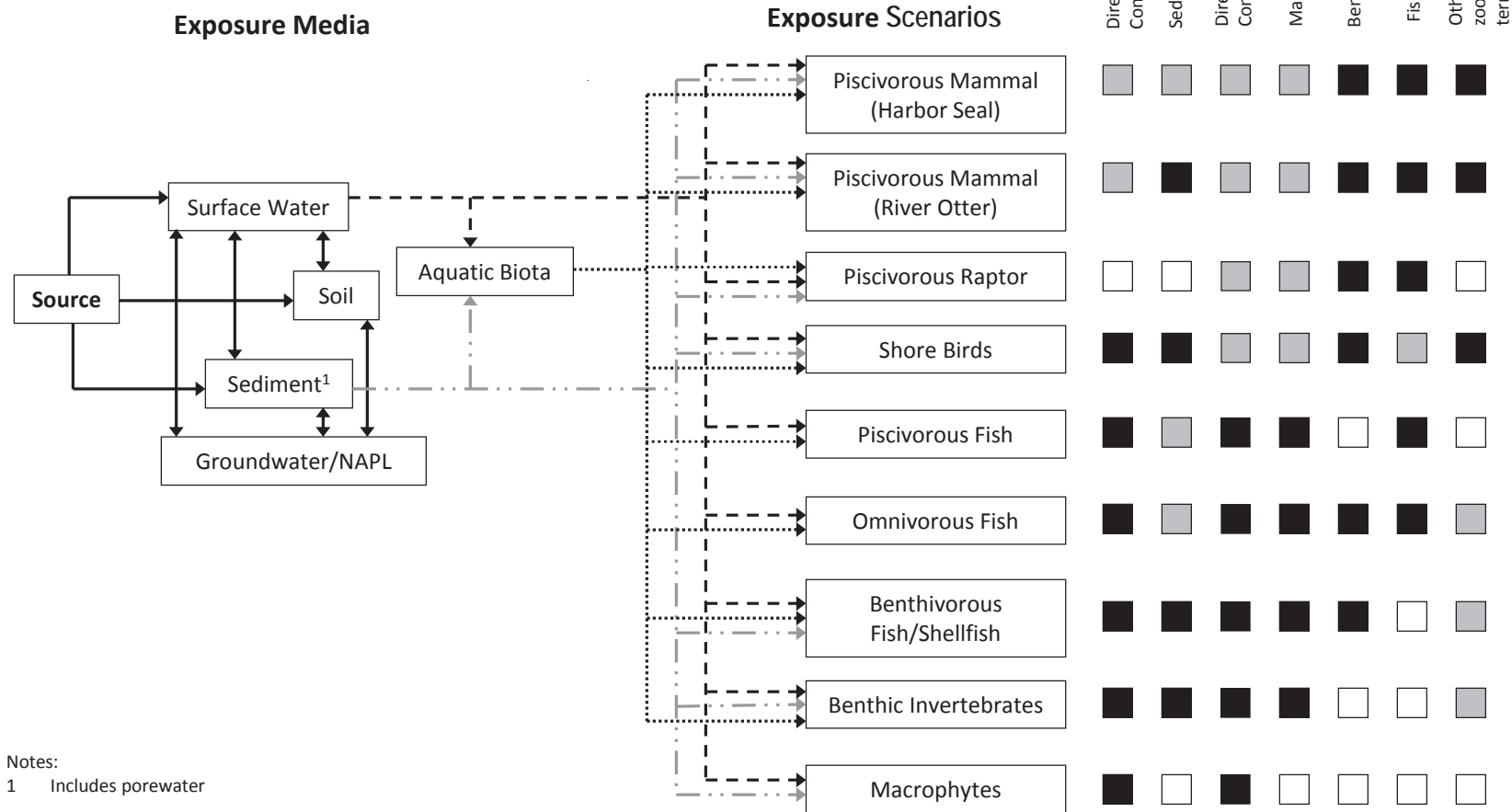
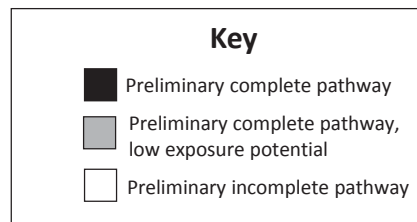
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



FIRM:
ANCHOR
DRAWN BY:

FIGURE NO.

4-3



Notes:
1 Includes porewater

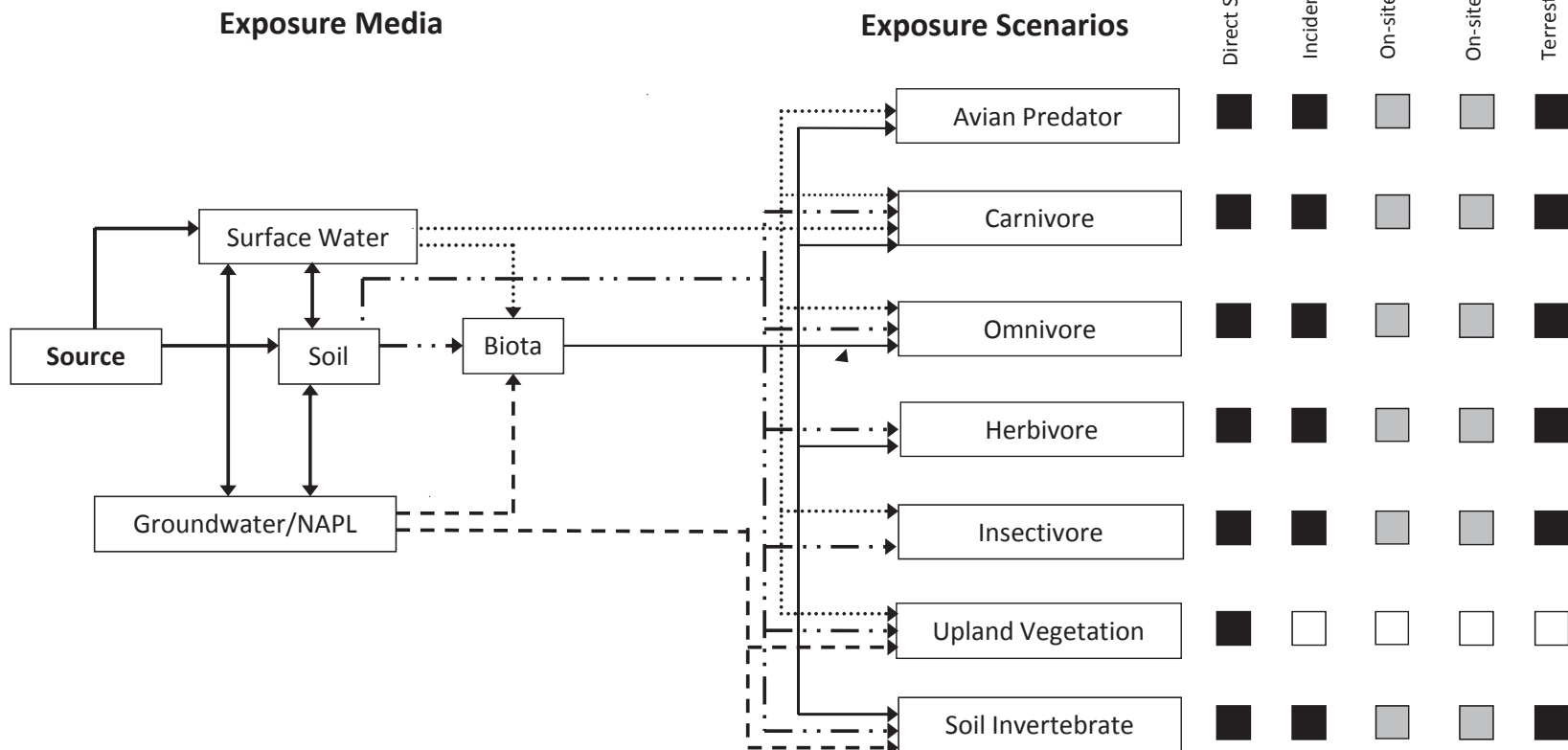
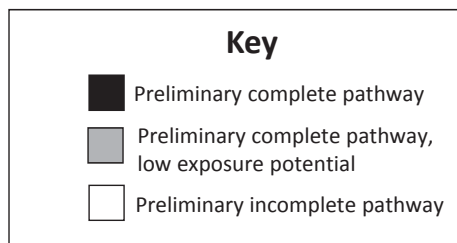
Aquatic Dependent Wildlife Conceptual Site Model

Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



FIRM:
ANCHOR
DRAWN BY:

FIGURE NO.
4-4



Notes:

The majority of the upland portion of the Gas Works site is paved. Unpaved areas include the adjacent bluff and former ravine. On-site freshwater is ephemeral and consists of ponding after rain events.

**Terrestrial Wildlife
Conceptual Site Model**

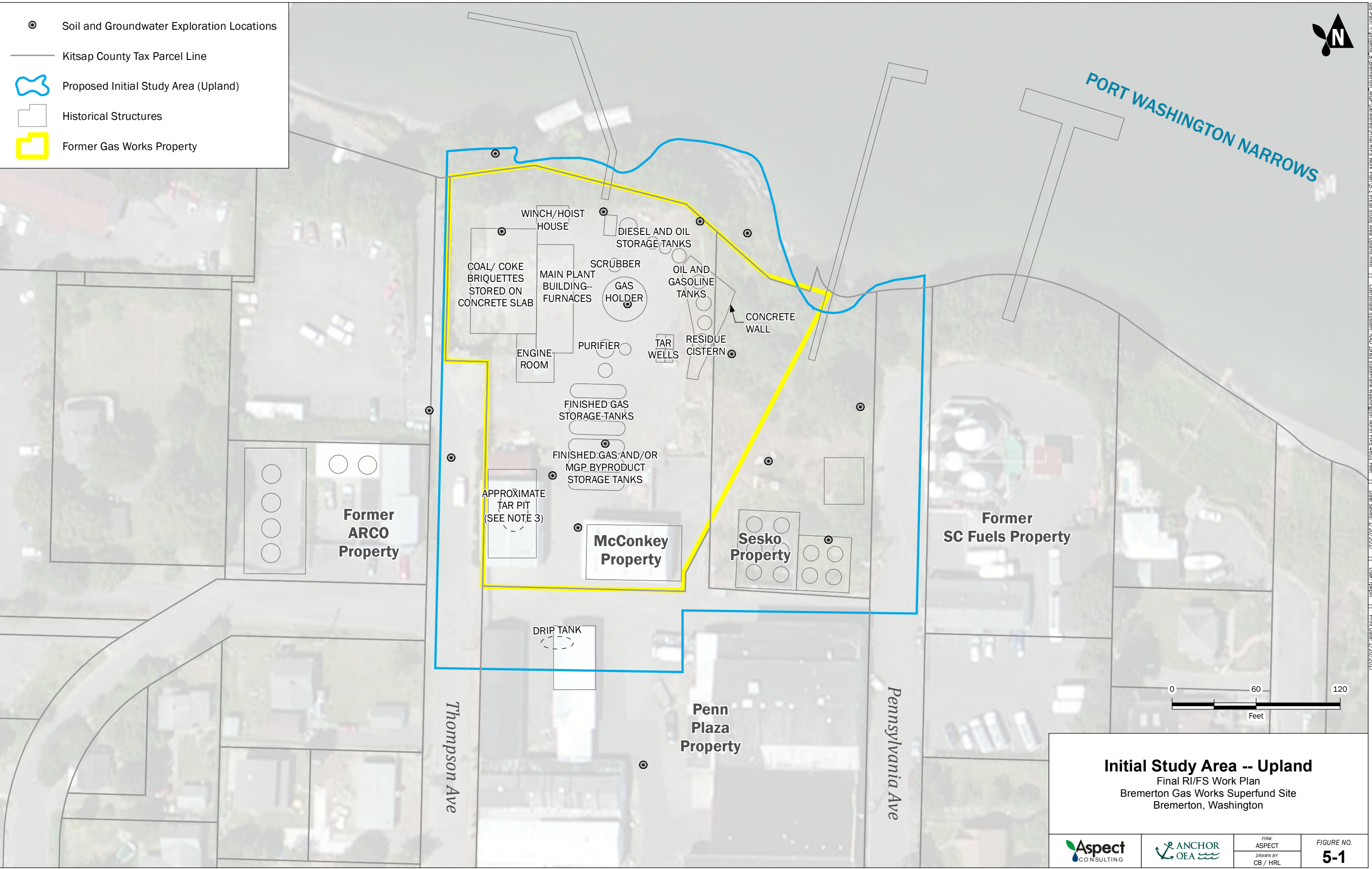
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



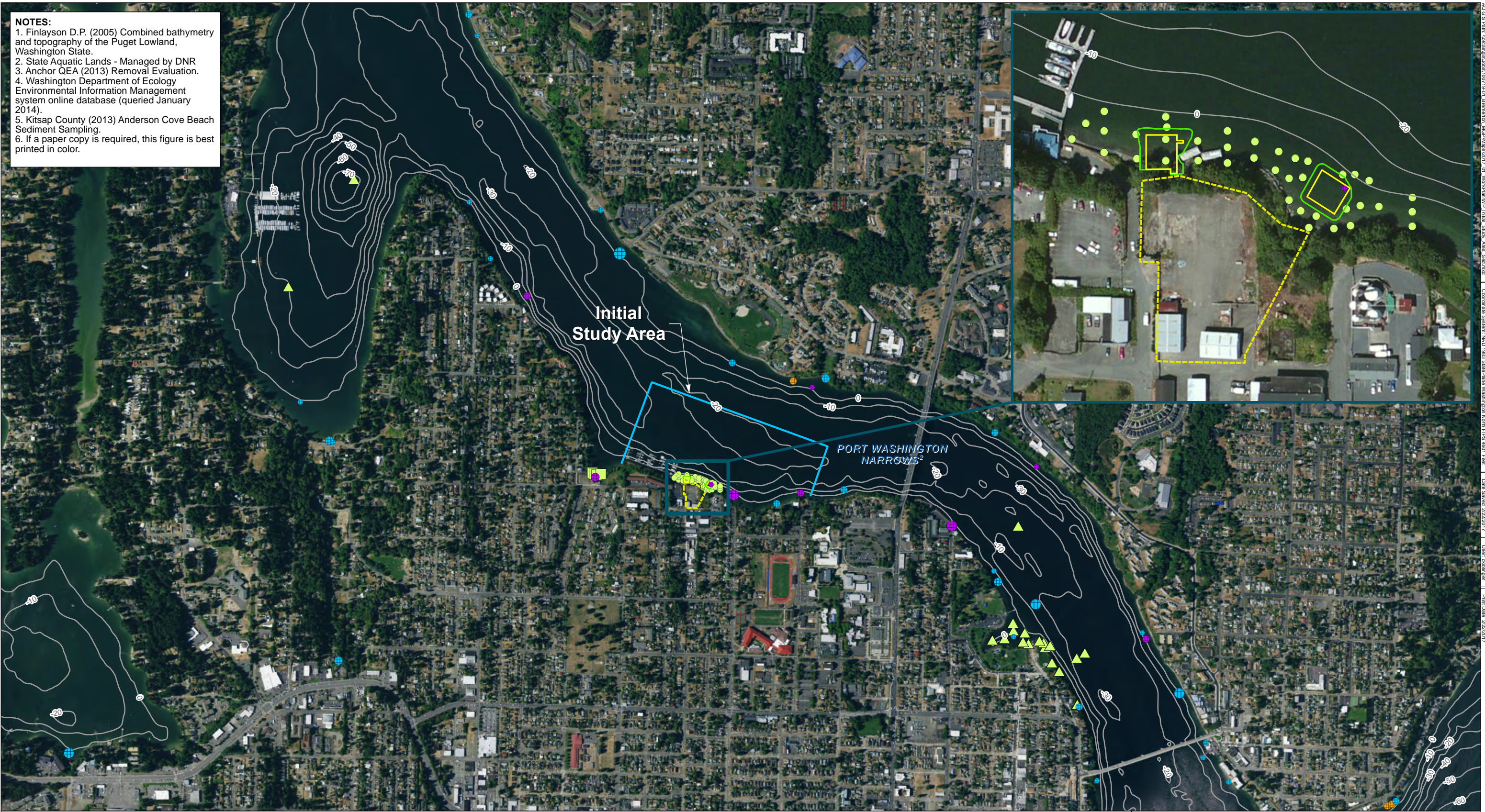
FIRM:
ANCHOR
DRAWN BY:

FIGURE NO.

4-5



NOTES:
1. Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. State Aquatic Lands - Managed by DNR
3. Anchor QEA (2013) Removal Evaluation.
4. Washington Department of Ecology Environmental Information Management system online database (queried January 2014).
5. Kitsap County (2013) Anderson Cove Beach Sediment Sampling.
6. If a paper copy is required, this figure is best printed in color.



Initial Study Area³

Former Gas Works Location

Cover of Existing Organoclay Mat (10-inch minus rock)²

Extent of Existing Organoclay Mat²

Surface Sediment Data Source

Anchor QEA³

EIM⁴

Kitsap County⁵

Outfall Size (inches)

8 - 12

13 - 24

25 - 36

37 - 48

49 - 60

61 - 72

73 - 84

Outfall Type

Combined Storm Drain/CSO Outfall

CSO Outfall

Storm Drain

PSDEM 2005 10-foot Contours¹

0

500

1,000

Feet

1:13,327

Initial Study Area – Sediments
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Aspect

CONSULTING

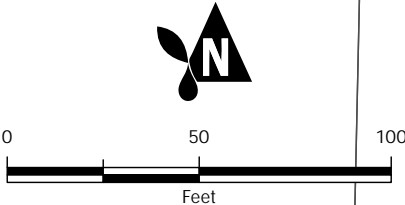
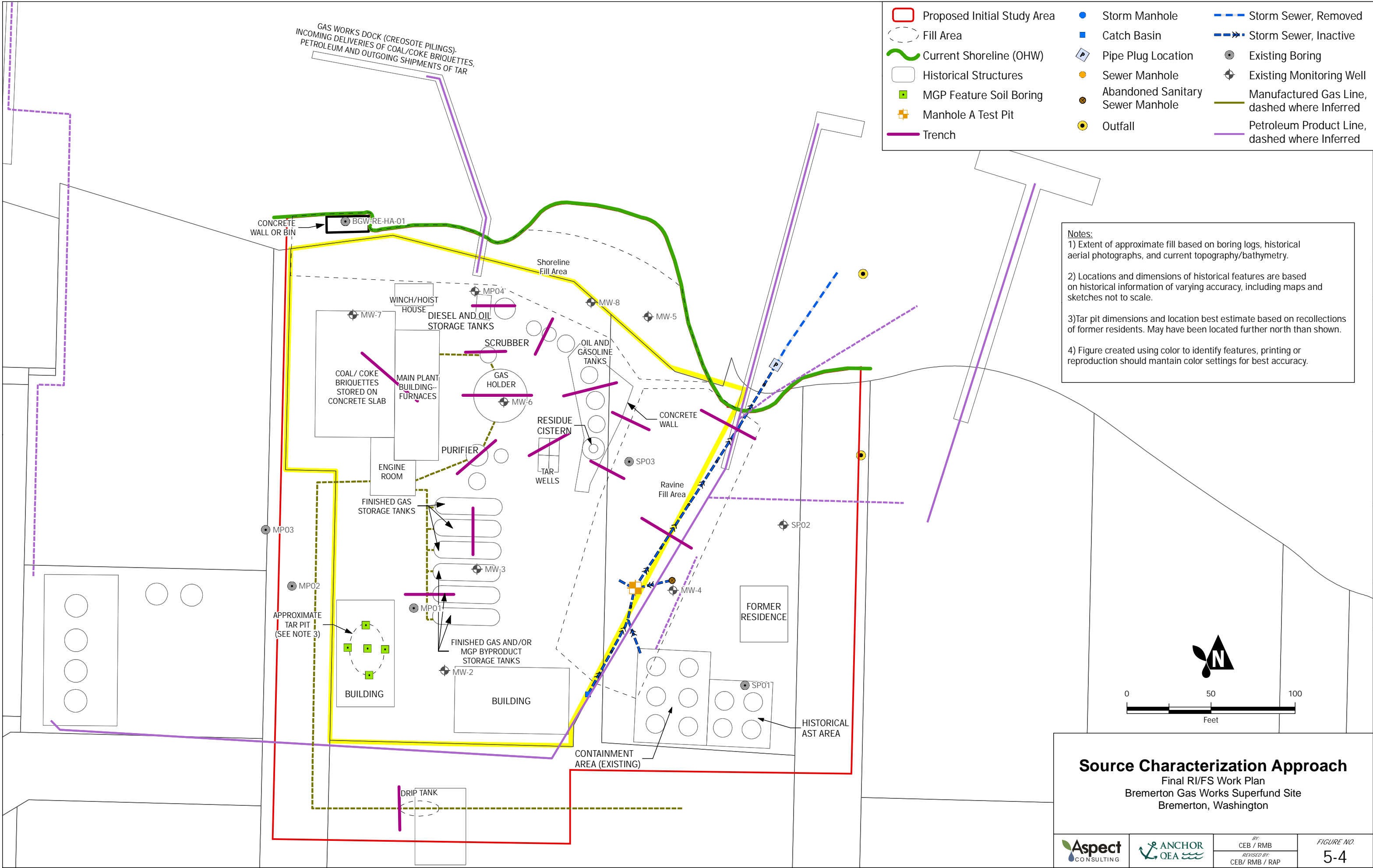
ANCHOR

QEA

FIRM:
ANCHOR QEA

DRAWN BY:
ckiblinger

FIGURE NO.
5-2



Source Characterization Approach
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



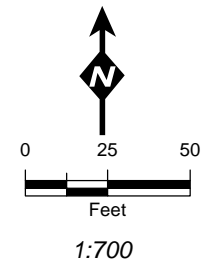
BY:
CEB / RMB
REVISED BY:
CEB/ RMB / RAP

FIGURE NO.
5-4

NOTES:
1. Site-associated bathymetry from survey conducted by eTrac; provided on May 15, 2013. 0-ft contour = Mean Lower Low Water (MLLW).
2. See Final Completion Report, Former Bremerton MGP Site, Incident Action and Time Critical Removal Action, January, 2011. Locations are approximate.
3. State Aquatic Lands - Managed by DNR.
4. If a paper copy is required, this figure is best printed in color.



- | | | | |
|--|--|--|--|
| <ul style="list-style-type: none">● Surface Sediment Grab● Subsurface Core and Surface Grab○ Supplemental Analysis and ex situ Porewater Testing□ Beach Shellfish Survey Location▽ Surface Water Locations | <ul style="list-style-type: none">▨ Historical Structures Associated with the Gas Works▨ Historical Structures Not Associated with the Gas Works▨ Existing Buildings▨ Former Gas Works Location | <ul style="list-style-type: none">■ 2010 TCRA/IA Pipe Plug Location²▨ Cover of Existing Organoclay Mat (10-inch minus rock)²▨ Extent of Existing Organoclay Mat²— Assumed City of Bremerton 12-inch Storm Water Pipe Configuration▨ Approximate Riprap Area | <ul style="list-style-type: none">— Bathymetry/Topography Contours (MLLW ft)¹- - - Site-associated Bathymetry Extent |
|--|--|--|--|



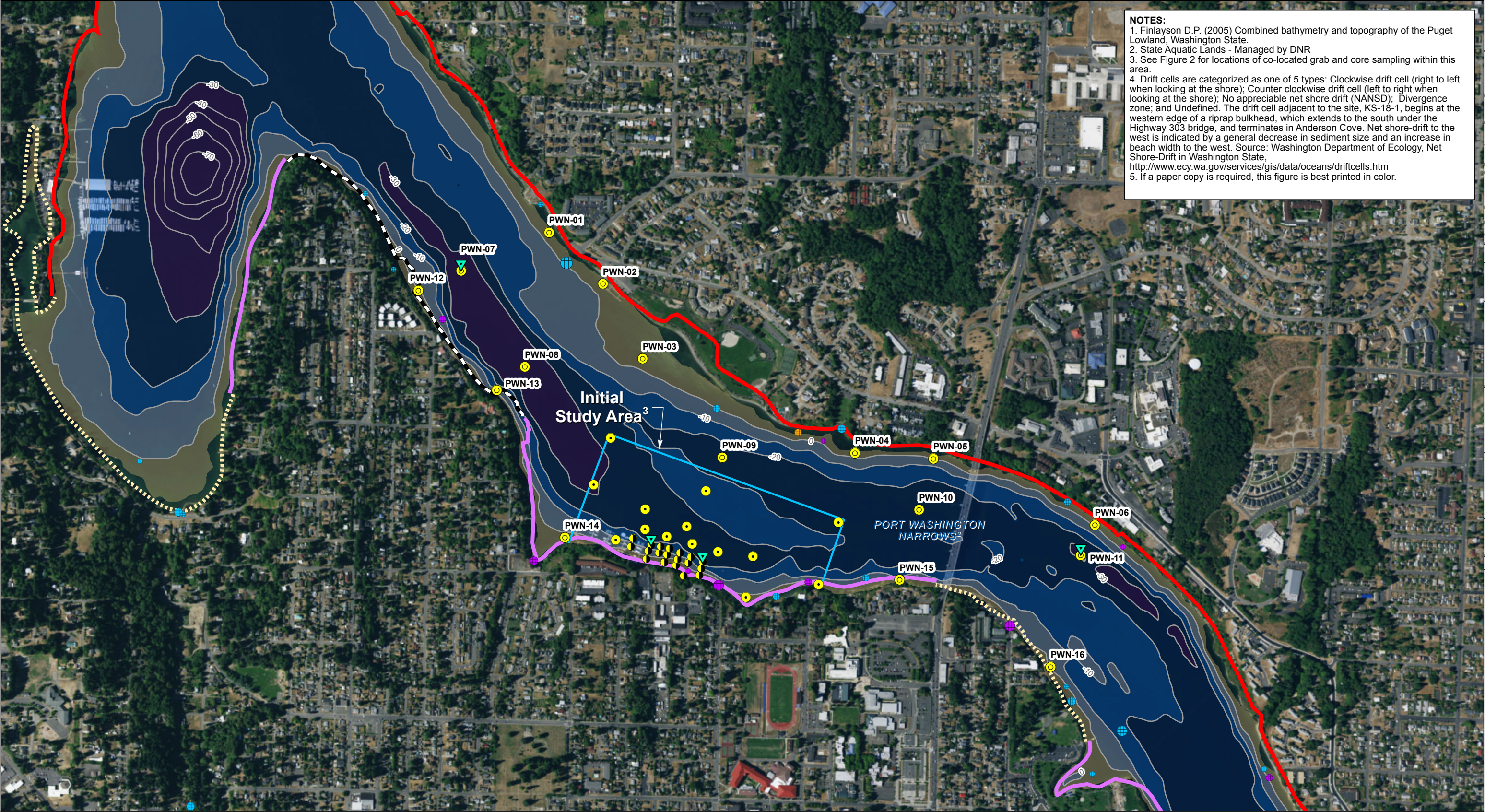
Initial Study Area
Grab and Subsurface Core Sampling Locations
Final RI/FS Work Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Aspect
CONSULTING

ANCHOR
QEA

FIRM:
ANCHOR QEA
DRAWN BY:
ckiblinger

FIGURE NO.
5-6



NOTES:
1. Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. State Aquatic Lands - Managed by DNR
3. See Figure 2 for locations of co-located grab and core sampling within this area.
4. Drift cells are categorized as one of 5 types: Clockwise drift cell (right to left when looking at the shore); Counter clockwise drift cell (left to right when looking at the shore); No appreciable net shore drift (NANSD); Divergence zone; and Undefined. The drift cell adjacent to the site, KS-18-1, begins at the western edge of a riprap bulkhead, which extends to the south under the Highway 303 bridge, and terminates in Anderson Cove. Net shore-drift to the west is indicated by a general decrease in sediment size and an increase in beach width to the west. Source: Washington Department of Ecology, Net Shore-Drift in Washington State, <http://www.ecy.wa.gov/services/gis/data/oceans/driftcells.htm>
5. If a paper copy is required, this figure is best printed in color.

ISA Surface Locations

Port Washington Narrows Surface Sediment Locations

Subsurface Core and Surface Grab

Surface Water Locations

Initial Study Area³

Outfall Size (inches)

8 - 12

13 - 24

25 - 36

37 - 48

49 - 60

61 - 72

73 - 84

Outfall Type

Combined Storm Drain/CSO Outfall

CSO Outfall

Storm Drain

Drift Cells⁴

Undefined

Divergent zone

Transport zone (left to right)

Transport zone (right to left)

No appreciable drift

Reported Bathymetry (MLLW ft)¹

10 to 0

0 to -10

-10 to -20

-20 to -30

Below -30

10-foot Contours¹

0

400

800

Feet

1:10,000

Port Washington Narrows Sampling Locations

Final RI/FS Work Plan

Bremerton Gas Works Superfund Site

Bremerton, Washington

Aspect

CONSULTING

ANCHOR

QEA

FIRM:

ANCHOR QEA

DRAWN BY:

ckiblinger

FIGURE NO.

5-8

Final Remedial Investigation/Feasibility Study Work Plan

APPENDICES A-H

Bremerton Gas Works Superfund Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01
May 19, 2017

Prepared by



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Upland Sampling and Quality Assurance Project Plan

Appendix A of the Final RI/FS Work Plan

Bremerton Gas Works Superfund Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01

May 31, 2017

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Upland Sampling and Quality Assurance Project Plan

Appendix A of the Final RI/FS Work Plan

Bremerton Gas Works Superfund Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01

May 31, 2017

Aspect Consulting, LLC & Anchor QEA, LLC

Approvals:

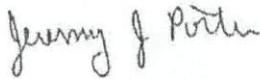


Project Manager

Kalle Godel, CNGC

May 31, 2017

Date




Project Manager

Jeremy Porter, PE, Aspect Consulting

May 31, 2017

Date



Field Coordinator

Carla Brock, LG, Aspect Consulting

May 31, 2017

Date



QA/QC Manager

Lea Beard, Aspect Consulting

May 31, 2017

Date



Quality Assurance Manager

Donald M. Brown, EPA

6/2/17

Date



Remedial Project Manager

Eva DeMaria, EPA

6/2/2017

Date

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Abbreviations

Anchor QEA	Anchor QEA, LLC
AOC	Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study
Aspect	Aspect Consulting, LLC
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cascade	Cascade Natural Gas Corporation
COPC	contaminant of potential concern
DOT	Washington State Department of Transportation
DQO	data quality objective
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EM	electromagnetic
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
GPR	ground-penetrating radar
GPS	global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
ISA	initial study area
LCS/LCSD	laboratory control samples/laboratory control sample duplicate
mg/L	milligram(s) per liter
MQI	measurement quality indicator
MS/MSD	matrix spike/matrix spike duplicate
NAPL	non-aqueous phase liquid
NTU	nephelometric turbidity units
PAH	polycyclic aromatic hydrocarbon
PID	photoionization detector
PM	project manager
PPE	personal protective equipment
PRG	preliminary remediation goal
PSI	pounds per square inch
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
RPD	relative percent difference
SDG	sample delivery group
Site	Bremerton Gas Works Superfund Site
SOPs	standard operating procedures
SOW	Statement of Work
SQAPP	Sampling and Quality Assurance Project Plan
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
UNC	Utility Notification Center
VOC	volatile organic compound

1 Introduction

Cascade Natural Gas Corporation (Cascade) is conducting a Remedial Investigation (RI) and Feasibility Study (FS) at the Bremerton Gas Works Superfund Site (Site) under the direction of the U.S. Environmental Protection Agency (EPA). This Upland Sampling and Quality Assurance Project Plan (SQAPP) has been prepared as Appendix A to the Final RI/FS Work Plan to describe specific sampling and analysis protocols for field sampling activities and quality assurance protocols for chemical and physical analysis. The work is being conducted in accordance with the Administrative Settlement Agreement and Order on Consent for Remedial Investigation Feasibility Study (AOC, EPA, 2013) and accompanying Statement of Work (SOW) for the Bremerton Gas Works Superfund Site.

1.1 Project Overview

The Final RI/FS Work Plan outlines the scope and rationale for the sampling and characterization efforts to be conducted at the Site. The Final RI/FS Work Plan is focused specifically on information necessary and sample data required to characterize the nature and extent of contamination at the Site, assess current and future potential risks to human health and the environment, and identify and evaluate remedial alternatives. The Upland SQAPP provides for the implementation of information and data collection activities described in the Final RI/FS Work Plan. The key data collection components to address the data needs identified in the Final RI/FS Work Plan are as follows:

- Geophysical surveys: Electromagnetic (EM) conductivity, ground penetrating radar (GPR) and electrical resistivity (ER) surveys will be conducted to identify and locate buried features or anomalous conditions in the shallow subsurface that may indicate historical use or fill material.
- Source Characterization. The investigation activities will start with what is currently known about the Site and its operational history and investigate potential sources to identify, delineate and characterize sources at the Site. This work will include a combination of trenches and borings in areas where historical information indicates that sources may exist and potential source areas identified by the geophysical surveys to identify and delineate the lateral and vertical extent of each source or source area.
- Source Areas Investigation. This work will move out from the sources to define Source Areas, where similar source materials are in relatively close proximity based on characteristics and location of sources identified in the Source Characterization, to define the magnitude and extent of Site contaminants of potential concern (COPCs) in soil and groundwater associated with each Source Area and to assess the presence and characteristics of non-aqueous phase liquid (NAPL). This work will include soil borings, soil sampling and analysis, monitoring well installation and groundwater sampling and analysis.

- **Outside Source Area Characterization.** Additional work will be completed to characterize the physical site environment to support development of the conceptual site model and to collect data to conduct the risk assessment. Some of the objectives specified for this phase of work may be met through investigation completed during previous phases of work. But where sufficient data has not been collected, additional work will be completed to characterize the physical characteristics and quality of native soil, identify and characterize water-bearing zones and aquitards, and characterize groundwater quality cross-and up-gradient of source areas. This work will include a combination of soil borings and monitoring well installation and groundwater monitoring and sampling. If appropriate, incremental-sampling methodology (ISM) may be implemented to characterize shallow soil quality for evaluating potential risks to human and ecological receptors as part of the risk assessment.
- **Groundwater Testing and Monitoring.** A groundwater testing and monitoring program will be implemented to measure hydraulic conductivity of water-bearing zones, evaluate groundwater-surface water interaction and tidal influence on groundwater conditions, and evaluate trends in groundwater quality over time. This work will likely include performance of slug tests and a tidal study and quarterly groundwater monitoring and sampling.

The scope of work for each of these components will be dependent on the results of the previous components, with the intent of working from the known to the unknown and making informed decisions about the number, type, and location of each exploration to meet specific objectives. The Site COPCs include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), cyanide, metals, polychlorinated biphenyls (PCBs), chlorinated pesticides and dioxins/furans. This SQAPP includes details regarding daily field communications and data sharing and decision points for determining, in consultation with EPA, the specific scope of work, methodology and approach for each component of the investigation. Final Draft RI/FS Work Plan identifies potential contingency studies that may be required to complete the RI/FS depending on the collected data. If contingent studies are warranted, these would be described in a work plan addendum that includes a supplemental SQAPP.

1.2 Proposed Study Area Boundaries

The initial study area (ISA) for the upland portion of the Site is defined in the Final RI/FS Work Plan. The upland portion of the ISA includes the Former Gas Works Property and portions of neighboring properties where gas works operations, including byproduct storage and disposal, are documented or suspected to have occurred, and areas where contamination associated with operations other than the former gas works could potentially be commingled with gas works contamination. The existing data collected from areas near the boundaries of the ISA suggest that contamination associated with the former gas works may not extend beyond the upland ISA but additional data are needed to determine if this is the case. The upland ISA boundary is depicted on Figure A-1.

1.3 Document Organization

This SQAPP was prepared in accordance with EPA's guidance for developing QAPPs (Quality Assurance Project Plans; EPA 2002). EPA's guidance specifies four groups of information that must be included in a QAPP (Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability). Each group comprises multiple QAPP elements.

The remainder of this SQAPP is organized into the following sections:

- Section 2—Project Management
- Section 3—Data Generation and Acquisition
- Section 4—Assessments and Response Actions
- Section 5—Data Validation and Usability
- Section 6—References

2 Project Management

2.1 Project/Task Organization

Aspect Consulting, LLC (Aspect) will lead the upland portion of the RI/FS investigation activities on behalf of Cascade. Anchor QEA, LLC (Anchor QEA) will lead the marine portion of the RI/FS investigation activities. This document addresses only the upland components; the marine components are addressed in the Marine SQAPP (Appendix B). The primary responsibilities of the team members for the upland portion of the RI/FS investigation are described in the following paragraphs.

Aspect Project Manager (PM): Jeremy Porter, P.E., will serve as the Aspect PM and will be responsible for overall project coordination and providing oversight on planning and coordination, work plans, all project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the scope of work. He will also be responsible for coordinating with Anchor QEA, who will lead the marine portion of the RI/FS investigation activities, and EPA on schedule, deliverables, and other administrative details.

Field Coordinator: Carla Brock, L.G., will serve as the Aspect field coordinator for the upland portion of the RI/FS. The field coordinator is responsible for managing the field sampling activities and general field and QA/QC oversight. She will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and will ensure timely delivery of environmental samples to the designated laboratories. The field coordinator will also provide QA oversight for the field sampling programs to ensure that samples are collected and documented appropriately.

Quality Assurance/Quality Control: Parker Wittman will provide QA oversight for laboratory programs to ensure data quality, oversee data validation, and supervise project QA coordination. Third-party data review and validation of analytical chemistry data will be provided by Pyron Environmental, Inc. Mingta Lin will act as the data validation project manager for Pyron Environmental, Inc.

Laboratory Project Manager: Michael Erdahl is the laboratory project manager with Friedman & Bruya, Inc. Sue Dunnihoo is the laboratory project manager with Analytical Resources, Inc. The laboratory project manager will oversee all laboratory operations associated with the receipt of the environmental samples, all chemical and physical analyses, and preparation of laboratory reports. The laboratory project manager will review all laboratory reports and prepare case narratives describing any anomalies and exceptions that occur during sample handling and analysis.

Data Manager: Lea Beard will oversee data management to ensure that analytical data are incorporated into the project database with appropriate qualifiers following acceptance of the data validation/ QA/QC of the database entries will ensure accuracy for use in the RI.

2.2 Problem Definition/Background

The Upland SQAPP describes the sampling and analysis approach for addressing the data gaps identified in the Final RI/FS Work Plan. The collection of supplemental data will support the definition and characterization of source areas, define the nature and extent of contamination, provide sufficient information to calculate and assess the current and future potential risks to human health and the environment, and allow for the identification and evaluation of remedial alternatives. The scope of work for the upland portions of the RI/FS will consist of subsurface investigation and collection of soil and groundwater samples for chemical and physical analysis. The work is being conducted to assess potential source areas, define the locations and characteristics of fill material, evaluate the extent and characteristics of aquifers and aquitards, define the nature and extent of Site COPCs and non-aqueous phase liquids (NAPLs), and evaluate contaminant fate and transport. The procedures for conducting these activities are described in detail herein.

2.3 Project/Task Description and Schedule

Sampling activities described in the RI/FS Work Plan and this Upland SQAPP will be initiated following EPA approval and as outlined in the schedule in the Final RI/FS Work Plan.

2.4 Data Quality Objectives and Criteria

Data quality objectives (DQOs), including the Measurement Quality Indicators (MQIs)—precision, accuracy, representativeness, comparability, completeness, and sensitivity (namely PARCCS parameters)—and sample-specific RLs are dictated by the data quality objectives, project requirements, and intended uses of the data. For this project, the analytical data must be of sufficient technical quality to determine whether contaminants are present and, if present, whether their concentrations are greater than or less than applicable screening criteria based on protection of human health and the environment.

The quality of data generated through this RI will be assessed against the MQIs set forth in this QAPP. Specific QC parameters associated with each of the MQIs are summarized in Table A-1. Specific MQI goals and evaluation criteria (i.e., MDLs, RLs, percent recovery (%R) for accuracy measurements, relative percent difference (RPD) for precision measurements, are defined in Tables A-2 and A-3 for soil and groundwater, respectively. Definitions of these parameters and the applicable QC procedures are presented below.

2.4.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared with their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples and laboratory control samples/laboratory control sample duplicate (LCS/LCSD) for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision is quantitatively expressed as the relative percent difference (RPD) between the LCS/LCSD, MS/MSD, or laboratory duplicate pairs and is calculated with the following formula:

$$RPD (\%) = 100 \times \frac{|S - D|}{(S + D)/2}$$

where:

S = analyte concentration in sample

D = analyte concentration in duplicate sample

Analytical precision measurements will be carried out at a minimum frequency of 1 per 20 samples for each matrix sampled, or one per laboratory analysis group. Laboratory precision will be evaluated against laboratory quantitative RPD performance criteria as defined in Tables A-2 and A-3 for specific analytical methods and sample matrices. If the control criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on reported data.

2.4.2 Accuracy

Accuracy measures the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by “spiking” samples with known standards (surrogates, blank spikes, or matrix spikes) and establishing the average recovery. Accuracy is quantified as the %R. The closer the %R is to 100%, the more accurate the data.

Surrogate recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{MC}{SC} \times 100$$

where:

SC = spiked concentration

MC = measured concentration

MS percent recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{MC - USC}{SC} \times 100$$

where:

SC = spiked concentration

MC = measured concentration

USC = unspiked sample concentration

Accuracy measurements on MS samples will be carried out at a minimum frequency of 1 in 20 samples per matrix analyzed. Blank spikes will also be analyzed at a minimum frequency of 1 in 20 samples (not including QC samples) per matrix analyzed. Surrogate recoveries for organic compounds will be determined for each sample analyzed for respective compounds. Laboratory accuracy will be evaluated against the performance criteria defined in Tables A-2 and A-3. If the control criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation, and the data reviewer will comment on the effect of the deviations on the reported data.

2.4.3 Representativeness

Representativeness measures how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. The FSP sampling techniques and sample handling protocols (e.g., homogenizing, storage, preservation, and use of duplicates and blanks) have been developed to ensure representative samples. Only representative data will be used in the RI/FS. Exploration locations and field sampling procedures for RI/FS activities on the upland portion of the Site are described in Section 3 of this SQAPP.

The representativeness of a data point is determined by assessing the integrity of the sample upon receipt at the laboratory (e.g., consistency of sample ID and collection date/time between container labels and chain-of-custody forms, breakage/leakage, cooler temperature, preservation, headspace for VOA containers, etc.); compliance of method required sample preparation and analysis holding times; the conditions of blanks (trip blank, rinsate blank, field blank, method/preparation blank, and calibration blank) associated with the sample; and the overall consistency of the results within a field duplicate pair.

2.4.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This goal will be achieved through the use of standard techniques to collect samples, USEPA-approved standard methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

2.4.5 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid. Results will be considered valid if the precision, accuracy, and representativeness objectives are met and if RLs are sufficient for the intended uses of the data. Completeness is calculated as follows:

$$\text{Completeness (\%)} = \frac{V}{P} \times 100$$

where:

V = number of valid measurements

P = number of measurements taken

Valid and invalid data (i.e., data qualified with the R flag [rejected]) will be identified during data validation. The target completeness goal for this project is 95%.

2.4.6 Sensitivity

Sensitivity depicts the level of ability an analytical system (i.e., sample preparation and instrumental analysis) of detecting a target component in a given sample matrix with a defined level of confidence. Factors affecting the sensitivity of an analytical system include: analytical system background (e.g., laboratory artifact or method blank contamination), sample matrix (e.g., mass spectrometry ion ratio change, co-elution of peaks, or baseline elevation), and instrument instability.

2.5 Special Training Requirements/Certifications

All sampling personnel will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and 8-hour refresher courses, as necessary, to meet the Occupational Safety and Health Administration regulations.

2.6 Documentation and Records

This project will require central project files to be maintained at Aspect. Project records will be stored and maintained in a secure manner. Each project team member is responsible for filing all necessary project information or providing it to the person responsible for the filing system. Individual team members may maintain files for individual tasks, but must provide such files to the central project files upon completion of each task. Hard copy documents will be kept on file at Aspect or at a document storage facility throughout the duration of the project, and all electronic data will be maintained in the database at Aspect.

2.6.1 Field Records

All field activities will be recorded in a project field logbook maintained by the Field Coordinator. The field logbook will include a general description of all sampling activities, results of discussions associated with field sampling activities, sampling personnel, Site visitors, and weather conditions. The field logbook will also provide a record of all modifications to the procedures and plans outlined in the Draft RI/FS Work Plan and this Upland SQAPP. The field logbook is intended to provide sufficient documentation of data and observations to enable participants to reconstruct events that occurred during the sampling activities.

In addition to the field logbook, the following forms will be used to record pertinent information during the sampling activities:

- Field Boring Log

- Test Pit Log
- As-Built Well Completion Log
- Well Development Record
- Groundwater Sampling Record
- Sample Collection Log
- Investigation-Derived Waste (IDW) Log

Example field forms are provided in Attachment A.

2.6.2 Analytical Records

All activities and results related to sample analysis will be documented at the analytical laboratory. The analytical laboratory will provide analytical results in a data package for each sample delivery group or analysis batch. Each data package will contain all information required for a complete AQ review, including analytical data, method reporting limits and method detection limits; results for all QA/QC checks including blanks, surrogate spikes, internal standards laboratory control samples, matrix spike/matrix spike duplicates; a narrative of any problems or difficulties encountered and the measures taken to correct them; and copies of all laboratory datasheets and logs including chain-of-custody forms. Data will be delivered in an electronic format to the Aspect data manager, who will be responsible for oversight of data verification and validation and for archiving the final data and data quality reports in the project file. Electronic data deliverables (EDDs) will be compatible with the project database.

2.6.3 Data Reduction

Data reduction is the process by which original data (analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subject to further review by the Laboratory Manager, the Project Manager, the QA/QC Manager, and independent reviewers. Data reduction may be performed manually or electronically. If performed electronically, software used must be free from error.

2.7 Field Communication Plan

During routine field activities, such as periodic Site inspections, well development, or groundwater monitoring events, field personnel will update the field coordinator and the project manager and field records will be saved in the project file. EPA will be informed of scheduled and completed field activities. Deviations from the Work Plan, or other issues warranting EPA attention, will be communicated to EPA immediately.

During non-routine field activities, such as during periods of subsurface explorations, the following communications will be instituted:

- Field activities and field data (including daily logs, photos, maps/sketches, and monitoring forms) will be posted within 24 hours to a password-controlled website for review by Cascade and EPA project teams. These draft work products will undergo QA/QC review after posting, and may be revised prior to inclusion in AOC-required documents. The website will be set up, tested, and approved by EPA and Cascade prior to beginning field work.
- Information relevant to field decision-making, such as preliminary analytical data (including pre-validated laboratory reports, summary data tables and/or figures, as appropriate), maps, cross-sections, or other analyses, will also be posted to the website as needed, and Cascade and EPA project team members will be informed via email.
- Conditions requiring immediate EPA notification include:
 - Deviations from the Work Plan;
 - Unanticipated Site conditions that affect the scope of work;
 - Conditions exhibiting an immediate threat to human health or the environment; and
 - Conditions that result in significant schedule delays (e.g., equipment breakdowns).
- A weekly status call during extended periods of field activities (i.e., longer than 1 week) will be scheduled with EPA and Cascade project teams. Additional meetings or teleconferences to discuss field activities and preliminary data may be scheduled as needed.

3 Data Generation and Acquisition

To ensure that the data collected under the specifications of this Upland SQAPP achieve an acceptable level of quality, appropriate QA/QC procedures will be followed at all phases of sample collection and analysis. This section presents a summary of the sampling design, a detailed description of the sampling methods and sample handling requirements and a summary of the QA/QC procedures. Depending on field conditions, the sample locations and sampling methods specified in Section 3.2 may be modified in the field if necessary to meet the sampling objectives. Any modifications will be noted in the field logbook and described in the data report prepared to document the sampling activities.

3.1 Sampling Design – Upland Investigation

The data necessary to meet the sampling objectives will be collected through geophysical/topographic surveys and soil and groundwater sampling and analysis. This section presents the sampling design for the upland portion of the RI.

3.1.1 Site Preparation and Utility Locating

A Site reconnaissance will be performed prior to field activities to confirm the location of initial sampling locations and to insure adequate access. Subsequently, a subcontractor will clear vegetation from areas of the McConkey and Sesko properties, as necessary to facilitate the geophysical surveys and access the initial sampling locations. Most of the vegetation consists of non-native blackberry and scotch broom bushes that can be easily removed with standard construction equipment.

Prior to any subsurface work, underground utilities will be located and marked by a private utility location company in the work area. In addition to traditional methods of locating utilities, the results of geophysical surveys will be used to identify suspected subsurface utilities. The Utility Notification Center (UNC) will also be notified, at least 48 hours before initiation of subsurface work, to locate and mark utilities within right-of-ways surrounding the properties on which the work will occur and within any utility easements in the vicinity of the work area.

After utilities have been located and the initial investigation locations are defined, a subcontractor will core the concrete at boring/drilling exploration locations, where present. Many of the boring/drilling explorations will be completed within asphalt, which will be cored by the driller at the time of drilling, or within areas of exposed ground surface, where no surface coring will be necessary. If there are suspected or unknown utilities in the vicinity of a planned exploration, a vacuum truck equipped with an air knife will be used to clear the exploration location to an approximate depth of 6 to 8 feet below ground surface (bgs) before commencing drilling.

3.1.2 Geophysical Surveys

Three separate geophysical surveys will be conducted by hydroGEOPHYSICs, Inc. to evaluate subsurface conditions and identify potential source areas for further evaluation as part of the Source Investigation. Each geophysical survey has been designed to meet specific objectives over a specified area, defined by historical activity and current ground surface conditions. An electromagnetic induction (EM) survey will cover all the upland ISA, except for the Shoreline Fill Area, and the nearshore portion of the marine ISA, as depicted on Figure A-1 to identify subsurface metallic objects, shallow subsurface filled pits or trenches, and areas where subsurface fluid or contaminant has pooled. The EM survey will be completed in one day with data compiled, processed and visualized overnight. A ground penetrating radar (GPR) survey will be conducted the following day to provide additional characterization for subsurface metallic objects identified by the EM survey and evaluate for non-metallic subsurface structures, filled pits or changes in shallow subsurface soil types that may indicate limits of fill material. The GPR survey is limited by ground surface conditions¹ and will be targeted to further refine objects identified during the EM survey, with a maximum extent of the paved or bare and flat portions of the McConkey Property (Figure A-1). An electrical resistivity (ER) survey will be completed following the EM and GPR surveys to provide subsurface characterization of native and fill soils in the Former Ravine Area through the completion of three transects (Figure A-1). The GPR data and ER data will be compiled, processed and visualized by the geophysical contractor in the office following completion of the field data collection. The results and interpretations of the geophysical surveys will be provided to EPA prior to the source investigation.

3.1.3 Topographic Survey

A supplemental topographic survey will be conducted to accurately locate and document Site features and ground surface elevations across the McConkey and Sesko properties where topographic data does not currently exist. The survey will be completed by a licensed surveyor. Survey data will be provided in hard copy and CAD format. The survey datum will be the nearest local datum to be consistent with the existing bathymetric survey.

3.1.4 Source Characterization

The Source Characterization will be completed to identify, delineate and characterize sources at the Site. A ‘source’ is defined as media that exhibits gross contamination such as tar or NAPL or other MGP-related feedstocks or byproducts, such as ash, slag, purifier waste, that may be providing an ongoing source of Site COPCs to another media. The Source Characterization will also locate and identify underground or buried structures,

¹ GPR survey equipment may not be applicable in areas of steep slopes, surface structures or other obstructions (e.g., debris, vegetation).

such as tanks, drums and piping, from where a source may originate. Indications of source material include the following:

- Presence of NAPL as LNAPL (e.g., diesel or light oil) or DNAPL (e.g., tar or heavy oil) in buried tanks, piping, concrete structures or other historical containment features.
- Presence of NAPL as diesel or light oil, present in saturated soil as indicated by free-phase product in the soil pore space or heavy sheen and staining of soil.
- Presence of NAPL as coal tar or heavy oil as indicated by pooled liquid or semisolid to solid, weathered product in soil. Coal tar will appear dark reddish brown to black with a very strong asphalt- or mothball-like odor and have a consistency ranging from vegetable oil to soft asphalt.
- Ashy material, either by itself or mixed with soil or other fill material.
- Slag or clinker, as black, loose granular or shiny fused material, either by itself or mixed with soil or other fill material.
- Purifier waste, as indicated by the presence of lime, dark and/or decomposed wood chips, iron filings and/or blue-staining that indicates the presence of cyanide, either by itself or mixed with soil or other fill material. Purifier waste may contain minor amounts of coal tar.

During the Source Characterization, trenches will be excavated using standard construction equipment (e.g., backhoe or trackhoe) operated by a subcontractor, and borings will be completed using direct-push drilling equipment, operated by a licensed driller. Preliminary exploration locations for this initial phase of work are depicted on Figure A-2; the locations may be modified based on the results of the geophysical surveys. Detailed soil logging, description, field screening and sampling procedures, including selection of samples for analysis and the analytical suite, are described in Section 3.2. The Source Characterization will be completed as follows:

1. Initial trench explorations will be completed to evaluate subsurface conditions near a suspected source. If a source is observed, the extent will be determined using excavation to define the limits, as practicable. The trench will be completed at depths sufficient to encounter potential source material given the known or suspected characteristics of the former structure or suspected source per the following:
 - a. Explorations intended to evaluate potential releases from surface sources, such as aboveground tanks used to store oil, gasoline or finished gas:
 - 1) If no indications of a source are observed, the trench will be completed at 6 feet bgs and no samples will be collected for laboratory analysis.
 - 2) If indications of a source are observed, the trench will be completed to a depth corresponding to 2 feet below the source, based on field screening results, or the maximum depth that is safely feasible, whichever is

b. Explorations intended to evaluate potential releases from shallow subsurface sources, such as underground piping or structures such as tar wells, will be completed at depths sufficient to determine the depth of the structure and the conditions beneath the structure:

- 1) If no indications of a source are observed, the trench will be completed at 6 feet bgs and no samples will be collected for laboratory analysis.
- 2) If indications of a source are observed, the trench will be completed to a depth corresponding to 2 feet below the source, based on field screening results, or the maximum depth that is safely feasible, whichever is shallower. A sample of the source material will be collected for potential laboratory analysis.

c. Explorations to evaluate the gas holder as a suspected source area will be completed at depths sufficient to determine the depth of the gasholder structure, if present, and the conditions at the base of the gasholder.

- 1) If no indications of a source are observed, the trench will be completed at a depth corresponding to 4 feet below the base of the gas holder structure, or the maximum depth that is safely feasible, whichever is shallower, or 6 feet bgs if no structure is observed. No samples will be collected for laboratory analysis.
- 2) If indications of a source area observed, the trench will be completed to a depth corresponding to 2 feet below the source, or the maximum depth that is safety feasible, whichever is shallower. A sample of the source material will be collected for potential laboratory analysis.

d. Explorations intended to evaluate the character of fill material in the Former Ravine will be completed to the shallower of native soil or the maximum safe depth of exploration, if surface conditions/ground stability will not safely support construction equipment large enough to extend the exploration deeper. Samples representative of each distinct source material observed in the ravine fill will be collected for potential laboratory analysis.

If source material is not observed in the trench exploration to the depths described above, the exploration will be backfilled with the excavated soil.

Where a source is observed in the initial trench exploration, a cross-trench will be excavated perpendicular to the original trench, where the source is strongest (i.e., more extensive or more highly contaminated), to determine the lateral extent and dimensions of the source. The cross-trench approach will follow the logic described above for the original trench excavations.

Where trench explorations are not practicable (e.g., beneath buildings), direct-push soil borings will be advanced to evaluate potential sources, per the following:

- a. If no indications of a source are observed, the borings will be advanced to native soil or refusal, whichever is shallower.
 - b. Where a source is observed, the borings will be advanced to a depth corresponding to 6 feet below the source or to refusal, whichever is shallower. A sample of the source material will be collected for potential laboratory analysis.
 - c. Where a source is observed, two step-out explorations will be completed along a transect at distances of 20-feet from the original exploration to evaluate the lateral extent of the source. Depending on the location, the step-out explorations may be either borings or test pit/trench explorations. A cross-transect of borings at 20-foot intervals will be advanced at the location where the source is strongest, based on field observations.
5. Where a source is observed that cannot be vertically characterized to at least 6 feet below the source through excavation methods, at least two soil borings will be advanced near, but not through the source material, to determine the vertical extent of the source, as follows:
- a. Sources near each other may be combined into larger source areas, for collective characterization of the vertical extent of source material.
 - b. Soil borings completed to delineate the vertical extent of each source or source area will be advanced to 16 feet below ground surface or to 6 feet below the source material, whichever is deeper. If refusal is encountered within fill material (e.g., on buried debris) before the target depth is reached, the boring will be relocated within five feet of the previous location. If refusal is met a second time, the exploration location will be abandoned and alternative investigation methods will be evaluated. If refusal is encountered due to dense native soils before the target depth is reached, alternative drilling methodologies (e.g., hollow-stem auger or sonic) will be employed to reach the target depth.

Soils collected from direct-push borings and test pits or trenches will be characterized by soil type and field screened for indications of Site COPC impacts and NAPL presence (see Section 3.2), and the results will be recorded. To evaluate the COPCs associated with identified sources, samples of source materials (e.g., NAPL or NAPL-coated soil) will be collected for laboratory analysis of the Site COPCs². At least one representative sample of each distinct source material will be submitted for laboratory analysis. If sufficient free-phase NAPL can be collected, NAPL samples will also be collected and submitted for petrophysical testing (density, viscosity, flashpoint).

Historic/abandoned piping that is identified or discovered during the geophysical surveys or the Source Characterization will be excavated and removed, if feasible and practicable.

² Site COPCs include VOCs, SVOCs, cyanide, metals, pesticides, and PCBs. Samples for potential dioxin/furan analysis will be collected and archived; analysis of archived samples will be dictated by the protocol described in Section 5.5.1.3.

The piping will be excavated and removed from the ground to a practicable extent, which may correspond to subsurface limitations (i.e. a building foundation), an aboveground structure, property boundaries beyond which excavation work may require street use permits or approvals of adjacent property owners, a depth beyond which an exploration excavation is no longer feasible without structural support or shoring, or other practicable limits. Explorations onto adjacent street rights-of-way or properties may be conducted if needed upon obtaining approval of property owners. If further investigation into piping location is warranted beyond practicable excavation limits, other methods may be employed to meet the investigation objectives (i.e. utility location, GPR surveys, etc.). Soil samples will be collected from beneath the piping at regular intervals, in lengths no greater than 20 feet, and the soil beneath and surrounding the piping will be field screened for indications of contamination. If piping remains in place beyond the feasible extent of removal, the end will be capped and sealed, and the GPS coordinates of its location will be recorded for future reference. If the origin of the piping remains unclear at the limits of feasible removal, a camera survey or further geophysical survey may be conducted to identify its origin and historic use.

The piping connected to Manhole A will be investigated in the same manner. Manhole A is currently filled with concrete debris and dirt, which is unlikely to be successfully removed without the removal of the manhole structure itself. Therefore, the source investigation will include the removal of Manhole A, identification and camera survey of any inlets identified, and collection of soil samples from the sidewalls and base of the excavation completed in the process of removing the manhole. Solid materials from inside the piping may be collected, if encountered, for chemical analysis to evaluate the former use of the pipe. Based on the expected depth of the manhole (approximately 14 feet), temporary shoring (e.g., trench boxes) will likely be required to complete this exploration.

3.1.5 Source Areas Investigation

Following the Source Characterization, the Source Areas Investigation will consist of the collection and analysis of soil samples from borings and groundwater samples from monitoring wells. The samples collected during the Source Areas Investigation will be analyzed for the full suite of COPCs³, except for dioxins/furans, whose presence will be analyzed for in a subset of soil samples where PCBs, chlorinated phenols, or chlorinated pesticides are detected above reporting limits, to evaluate the nature and extent of COPCs in soil and groundwater, and NAPL in soil, attributable to identified sources or source areas. The Source Areas Investigation will consist of the following:

1. Deep borings advanced along transects, oriented perpendicular to groundwater flow, and along the shoreline to evaluate potential migration of contaminants in

³As described in Section 3.2.5, samples exhibiting high levels of contamination that are likely to cause analytical interferences or instrumentation problems may not be analyzed for all analytes. For example, samples of potential tarry materials would not be analyzed for pesticides.

groundwater to the surface water of the Port Washington Narrows and to identify appropriate locations and construction details for installation of monitoring wells.

2. Installation and sampling of monitoring wells downgradient of Source Areas to evaluate the nature and extent of contamination in groundwater attributable to sources or Source Areas.

The Source Areas Investigation will include the advancement of borings using either Sonic or hollow-stem auger drilling methods for observation and documentation of soil types and aquifers and aquitards, collection of soil samples for physical and chemical analysis, construction of monitoring wells and collection of groundwater samples from all newly installed and existing monitoring wells. The specific exploration locations for the Source Areas Investigation are dependent on the previous phases of investigation but the general approach is described below. Soil logging and soil and groundwater sampling procedures are outlined in Section 3.2.

The Source Characterization will define the extent of each source or source area. Borings will be advanced during the Source Areas Investigation to evaluate the magnitude, nature and extent of COPCs in soil associated with each source or source area. Field screening will be conducted, as described in Section 3.2.4, and soil samples will be collected for chemical analysis from the ground surface to a total depth corresponding to either: 1) 20 feet below the deepest indication of contamination based on field screening; 2) 10 feet into a suspected aquitard, if no indications of contamination are identified within that unit⁴; or 3) bedrock. The soil analytical approach for the Source Areas Investigation is detailed in Section 3.2.6.2.

Groundwater flow is assumed to be towards the north, towards the surface water of the Port Washington Narrows. This assumption will be evaluated during early hydrogeologic characterization (Section 3.1.6). Deep borings advanced to characterize groundwater quality will be completed downgradient of each Source Area, which is assumed to be north of each Source Area but that will be confirmed prior to this phase of investigation work. Monitoring wells will be installed with screened intervals at variable depths to characterize the magnitude and vertical extent of COPCs in groundwater attributable to sources identified during the Source Characterization. Based on the previous investigation data, groundwater at the shallowest water table is present at a depth of approximately 30 to 35 feet bgs (relative to the ground surface of the McConkey Property). Where sources are identified above the water table, shallow monitoring wells will be constructed to appropriately characterize this shallowest water-bearing zone, with 10- to 15-foot screens constructed across the top of the water table. The screened interval for water table wells is estimated to be between 30 and 45 feet bgs. However, the final well construction details will be determined in the field based on the results of field observations. If an aquitard is

⁴ Field screening will continue to depths greater than 10 feet into the aquitard if evidence of contamination is observed.

encountered at a depth shallower than 45 feet bgs, the water table wells may be constructed with a shorter and/or shallower screened interval.

The screen length, location and total depth for additional monitoring wells will be determined based on field observations of the nature and extent of source material, lithologic units and groundwater occurrence, in accordance with the following decision criteria:

- Monitoring wells will be constructed to characterize the vertical extent of contamination in groundwater. Wells will be constructed to correspond vertically to the highest degree of source contamination observed in each boring at the time of drilling.
- Where source contamination is observed to extend throughout the water-bearing zone and an aquitard is identified, monitoring wells will be constructed with a 10-foot screen constructed at the base of the shallow water-bearing zone/top of the aquitard.
- Where source contamination in the water-bearing zone can be defined vertically, a monitoring well will be constructed with a 10-foot screen with the top of the screen at a depth corresponding to 20 feet below the deepest indication of contamination.
- If no aquitard and no contamination are observed in the boring, the monitoring well will be completed with the top of the 10-foot screen installed 20 feet below the bottom of the screen of the nearest water table well. For example, if the nearest water table well is constructed with a screen set from 35- to 50 feet bgs; the deep well will be constructed with a screen set from 70- to 80 feet bgs.

3.1.6 Outside Source Areas Investigation

The Outside Source Areas Investigation will consist of three main components to characterize the physical site environment and support development of the conceptual site model, to bound the extent of COPCs in soil and groundwater, and to complete the risk assessment. The three components include the following:

- Preliminary deep borings and wells, to identify and characterize water-bearing zones and aquitards and evaluate groundwater flow direction.
- Shallow soil characterization outside of the source areas to support preparation of the risk assessment and to define the lateral extent of COPCs in soil.
- Characterization of cross-gradient and up-gradient groundwater quality to define the extent of COPCs in groundwater and to characterize Site groundwater geochemical conditions.

The scope of work to be completed for each of these three components is summarized below. The field methods and analytical approach are presented in Section 3.2 and the sample handling requirements are summarized in Section 3.5.

3.1.6.1 Preliminary Deep Borings and Wells

Three initial deep borings will be advanced to characterize subsurface lithology and identify water-bearing units and aquitards and will be completed as groundwater monitoring wells to characterize hydrogeologic characteristics of deeper groundwater, including flow direction and gradient and groundwater-surface water interaction. The specific objectives and the work proposed to address them are as follows:

- **Define the vertical extent of the water-table aquifer.** Borings will be advanced until a suspected aquitard/confining layer, or bedrock, is encountered. If neither a suspected aquitard/confining layer or bedrock is encountered above a depth of 80 feet bgs, the boring will be terminated at 80 feet.
- **Evaluate the physical characteristics of the water-table aquifer.** Soil samples will be collected from the water-bearing unit that comprises the water-table aquifer for physical testing of grain size, density, porosity and total organic carbon content.
- **Evaluate the physical characteristics of the aquitard.** If encountered, collect soil samples from the suspected aquitard below the water-table aquifer for physical testing of grain size, density, porosity and total organic carbon.
- **Evaluate for the presence of a second, deeper aquifer.** Borings will be advanced into a suspected aquitard for a maximum of 20 feet. If there are no indications of a second, deeper aquifer, the borings will be abandoned and backfilled, either to the base of the water-table aquifer where a water-table monitoring well will be installed or to the ground surface, with no further vertical exploration.
- **Evaluate the physical characteristics of a second, deeper aquifer.** If encountered, soil samples will be collected from the deeper aquifer for physical testing of grain size, density, porosity and total organic carbon content.

A monitoring well will be constructed in each of the preliminary deep borings per the following logic:

- The wells will either be constructed with screens set at the base of the water-bearing zone/top of an identified aquitard or within a second, deeper aquifer, if encountered.
- If no aquitard is identified to the total exploration depth, monitoring wells will be constructed with a 10-foot screen set at 80 feet bgs.
- If an aquitard is identified at a thickness of less than 20 feet, monitoring wells will be constructed with a 10-foot screen constructed with the base of the well screen set at a depth of 10 feet below the top of the second, deeper aquifer.
- If no aquitard and no contamination are observed in the boring, the monitoring well will be completed with the top of the 10-foot screen installed 20 feet below

the bottom of the screen of the nearest water table well. For example, if the nearest water table well is constructed with a screen set from 35- to 50 feet bgs; the deep well will be constructed with a screen set from 70- to 80 feet bgs.

3.1.6.2 Shallow Soil Characterization

Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol that reduces data variability and provides a reasonably unbiased estimate of mean contaminant concentrations in a volume of soil targeted for sampling, termed a “Decision Unit” (DU; ITRC, date). ISM may be used at the Site to characterize shallow soil quality (up to 6-feet bgs), define the Site boundary, and/or inform the risk assessment outside of the source areas.

The proposed DUs for the ISM sampling will be defined based on the results of the source investigation (Section 3.1.5). For the purposes of this workplan, we have assumed the study area will be divided into a maximum of 16 DUs. Each DU will consist of two vertical intervals: ground surface to 3 feet bgs, Interval 1; and, 3 feet bgs to 6 feet bgs, Interval 2, based on consideration of human health and ecological exposure pathways. The sampling procedures described in Section 3.2.5 will be consistent between all DUs.

The sampling design describes two separate sample types: 1) standard ISM samples to be submitted for laboratory analysis of SVOCs, metals, pesticides, PCBs, and cyanide, and select samples for dioxins/furans; and, 2) discrete samples to be submitted for VOCs.

ISM Samples. Each DU will be subdivided by an internal grid consisting of 35 equally-sized subareas, to accommodate the collection of 30 incremental samples, per vertical interval, across the full DU while allowing for elimination of 5 grid squares for which field personnel decide are not sampleable (due to the presence of structures, inaccessible or unsafe areas, etc.). Three replicate samples of 30 increments each will be collected from each vertical interval, for a total of six samples for each DU. Each of the 30 increments obtained should weigh approximately 50 grams to ensure adequate replicate sample mass required for the specified laboratory analyses (1.5 kg).

Discrete VOC Samples. In addition to the ISM samples described above, discrete samples specifically obtained for VOC analysis will be collected at a frequency of one sample per 250 square feet of DU at each depth interval.

3.1.6.3 Cross- and Up-Gradient Groundwater Quality Characterization

Perimeter borings will be installed along the boundaries of the upland ISA and completed as water-table monitoring wells to evaluate the extent of contamination in soil and groundwater at the upper saturated zone. If contamination is detected in deeper monitoring wells, perimeter borings will be installed and completed as wells to define the lateral extent of groundwater in each affected water-bearing zone.

3.1.7 Groundwater Testing and Monitoring

Hydrogeologic testing and evaluation will be conducted in monitoring wells located in each water-bearing zone to determine the hydraulic conductivity of aquifer units and evaluate the influence of tidal fluctuation on groundwater levels. The procedures for slug test performance and data analysis are presented in Section 3.2.6.1. The procedures for tidal study data collection and analysis are presented in Section 3.2.6.2. An initial tidal study will be performed using the existing water-table wells and the initial deep wells (see Section 3.1.6) to assist in locating subsequent explorations. A second tidal study will be performed after the full extent of contamination is established.

3.2 Field Methods

3.2.1 Exploration and Sample Identification

All samples will be assigned unique identification codes based on a designation scheme designed to suit the needs of the field personnel, data managers and data users.

Soil explorations that are not completed as monitoring wells will consist of either “SB” for soil boring, “TP” for test pit or “TR” for trench, followed by a sequential exploration number. Soil samples collected from borings will be assigned a unique sample identification number including the boring number and the depth from which the sample was collected. For example, the soil sample collected from boring SB-20 at a depth of 7 to 8 feet bgs would be identified as SB20-7-8. Soil samples collected from test pits or trenches, where multiple samples may be collected from the same depth interval, will be given a sequential letter identifier. For example, the second soil sample collected from trench TR-7 at a depth of 7 to 8 feet bgs would be identified as TR7b-7-8.

The monitoring wells will be identified with a sequential well identification number, beginning with MW-9 for the water-table wells and MW-101 for deeper wells. An identification suffix for each well will indicate the water-bearing zone in which the well is constructed. Water-table wells will be indicated by a “WT,” for example, the location name for water-table well MW-9 would be “MW-9WT.” The identification suffix for deeper wells will indicate the screen depth. For example, the location name for well MW-101, which is constructed with the bottom of the screen set at 80 feet bgs would be “MW-101-80.” Each groundwater sample will be assigned a unique sample identification number that includes the well number and the 8-digit date on which the sample was collected. For example, a groundwater sample collected from monitoring well MW-101-X on May 30, 2015, would be identified as MW-101-X-053015.

3.2.2 Location Positioning

Horizontal coordinates for each soil sampling location will be recorded using a hand-held global positioning system (GPS) instrument with real-time differential correction. The horizontal coordinates and elevations of monitoring wells included in the assessment will be surveyed by a licensed surveyor relative to a common horizontal and vertical datum.

Monitoring well top-of-casing elevations will be surveyed to the nearest 0.01 foot, and horizontal coordinates to the nearest 0.1 foot, or better. Each well will be surveyed at the marked spot on the top of the PVC well casing from which depth-to-water measurements are collected.

3.2.3 Soil Sample Collection

Soil samples will be collected throughout the RI from test pits, trenches and borings for soil classification and field screening (Section 3.2.4) and laboratory analysis (Section 3.2.6). A general description of the sample collection procedures is summarized in the following sections. The sample collection procedure for ISM are described in Section 3.2.5.

All soil samples to be submitted for VOC analyses will be collected in accordance with U.S. Environmental Protection Agency (EPA) Method 5035A. The soil aliquot for VOC analysis will be collected from the undisturbed soil sample core using a laboratory-supplied modified disposable plastic syringe as required by the EPA Method 5035A, and placed in pre-weighed laboratory supplied vials. For all other analyses, the soil samples will be removed from the sampler using a decontaminated stainless steel spoon or a freshly-gloved hand. Gravel-sized material greater than approximately 0.5 inch will be removed from the sample during mixing. An aliquot of the homogenized soil will be placed into certified-clean jars supplied by the analytical laboratory.

For all other analyses, the soil samples will be removed from the sampler or backhoe bucket using a stainless steel spoon and placed in a stainless steel bowl for homogenization with the stainless steel spoon. Gravel-sized material greater than approximately 0.5 inch will be removed from the sample during mixing. A representative aliquot of the homogenized soil will be placed into certified-clean jars supplied by the analytical laboratory.

QC soil samples (e.g., field duplicates, rinsate blanks, and trip blanks) will be collected at the respective frequencies prescribed in Section 3.5.

3.2.3.1 Test-Pit/Trench Explorations

Test-pit and trench explorations will be completed through fill materials and into native soils, where practicable, to a minimum depth of 6 feet bgs unless health and safety considerations (e.g., sidewall sloughing) dictate otherwise. The maximum depth of the test pits and trenches will be dependent on the source being investigated, observations made during the investigation, the subsurface lithology and the limitations of the equipment given the location and surface conditions of the exploration. If the proposed test pit or trench cannot be completed because of concrete, debris or other impediments, the exploration location and/or type will be modified to meet the investigation objectives.

Soils from test pits will be logged and screened for evidence of contamination, and samples will be collected for chemical analysis, as described in Section 3.2.5.

Following sample collection and field logging, each test pit will backfilled with soil excavated from it. Where obvious and extensive contamination is observed, including soil with NAPL or cyanide, highly-contaminated soil may be segregated and handled as investigation-derived waste and containerized for transport and off-Site disposal. Clean soil will be imported to backfill these explorations and plastic sheeting will be used at the limits of the exploration to minimize recontamination of clean backfill. Many of the preliminary test pit and trench investigation locations are located in areas where the ground surface is bare ground covered by surface vegetation. The test pits excavated in asphalt or concrete areas on portions of the McConkey Property will be asphalted following completion of the field investigation.

Test-pit or trench soil logs, an exploration location map, and preliminary (pre-validated) chemical data will be provided to EPA for discussing if any adjustments to the scope of subsequent planned investigation activities are warranted. Any adjustments to the investigation program will be approved by the EPA RPM.

3.2.3.2 Direct-Push Borings

The drilling method used for the Source Characterization will likely consist of direct-push drilling. Direct-push drilling rigs use hydraulic cylinders and a hammer to advance a hollow core sampler for the collection of soil and groundwater samples. Soil cores will be collected continuously in 4- to 5-foot intervals using disposable, 1.5-inch diameter, clear plastic (polyvinyl chloride [PVC]) liners. The liners are sliced longitudinally and opened to access the soil core.

Soils from direct-push borings will be logged and screened for evidence of contamination, and samples will be collected for chemical analysis, as described in Section 3.2.6.

Following sample collection and field logging each boring will be backfilled with bentonite chips placed from the total depth of each boring to the ground surface. The ground surface will be patched with concrete or asphalt, or left as bare ground, to match the surrounding surface.

Boring logs, an exploration location map, and preliminary (pre-validated) chemical data collected during the shallow soil investigation will be provided to EPA. These preliminary results from the shallow soil investigation will be used to develop the specific scope of work and approach for the deep soil and groundwater investigation. The deep soil and groundwater investigation, along with any other adjustments to the investigation program, will be approved by the EPA RPM prior to commencing field work.

3.2.3.3 Sonic/Hollow-Stem Auger

The drilling method utilized for the Source Areas Investigation and Outside Source Areas Investigation will be dependent on the soil types and density observed during the Source Characterization and recommendations from the drilling contractor on which method is likely to be most successful at meeting the project objectives. A combination of direct-push and/or either sonic or hollow-stem auger drilling methods will be utilized.

If sonic drilling methods are employed, soil samples will be collected continuously in 5-foot intervals to the total depth of the exploration using a 3- to 4-inch diameter sampling core barrel inside an outer sonic drill casing. The sampling core barrel is driven by a high-frequency, vibrating sonic head, driven by hydraulic motors, in conjunction with rotational and downforce. The benefits of sonic over hollow-stem auger drilling methods include generation of smaller volumes investigation-derived waste, ability to reach greater depths and recover better core samples in dense soils, and ease of using temporary conductor casing to minimize potential contaminant drawdown from contaminated zones to clean zones.

If hollow-stem auger is employed during the deep soil and groundwater investigation, soil samples advanced using hollow-stem auger will be collected at 2.5-foot depth intervals to the total depth of exploration using a 2-inch-outside-diameter split-spoon sample tube driven into the ground at the bottom of a borehole by blows from a 140-or 300-pound slide hammer falling through a distance of 30 inches. The sample tube is driven 18 inches into the ground and the number of blows needed for the tube to penetrate each 6-inch increment is recorded. The sum of the number of blows required for the second plus third 6-inch increments of penetration is termed the "standard penetration resistance" or the "N-value". If 50 blows are insufficient to advance it through a 6-inch interval, the penetration after 50 blows is recorded. The split spoon sampler is decontaminated after each sample is collected. Hollow-stem auger drilling methods are quicker and more cost effective for drilling and installing relatively shallow wells, compared to sonic drilling methods, and collected blow counts can provide valuable information regarding the physical soil properties. Hollow-stem auger drilling rigs are more readily available than sonic drilling rigs in the region, and come in a wide variety of sizes and specifications for drilling on sites with access or safety limitations (low overhead clearance, ground stability concerns, etc.).

Soils from sonic/hollow-stem auger borings will be logged and screened for evidence of contamination, and samples will be collected for chemical analysis, as described in Section 3.2.6. Following sample collection and field logging each boring will either be backfilled with bentonite chips/hydrated bentonite, placed from the total depth of each boring to the ground surface, or completed as a groundwater monitoring well. For borings not completed as monitoring wells, the ground surface will be patched with concrete or asphalt, or left as bare ground, to match the surrounding surface.

3.2.4 Soil Classification and Field Screening

A geologist from Aspect will oversee the drilling and excavation activities and prepare a geologic boring or test pit/trench log for each of the explorations completed. The field representative will visually classify the soils in accordance with ASTM Method D2488 and record soil descriptions, field screening results, and other relevant details (e.g., staining, debris, odors, etc.) on the appropriate field form. If samples are collected for chemical analysis, the sample ID and depth will also be recorded on the log.

In addition to soil classification, the field representative will screen the soil using a photoionization detector (PID) to monitor for the presence of volatile organic vapors. The

PID will be calibrated daily in the field using the manufacturer's calibration standard (100 ppm isobutylene gas). A calibration test, referred to as a "bump test", will be performed as necessary in the field using the calibration gas to check that the PID remains properly calibrated throughout the day.

Soil samples will be field-screened for presence of petroleum using visual examination and water sheen tests. The following qualitative nomenclature for oil on soil samples will include:

- *No visible evidence.*
- *Sheen* – Sheen as described by the sheen testing nomenclature described below.
- *Staining* – Visible brown or black staining on soil. Can be visible as mottling or in bands. Typically associated with fine-grained soils.
- *Coating* – Visible brown or black oil coating soil grains. Typically associated with coarse-grained soils.
- *Oil Wetted* – Visible brown or black oil wetting the soil sample. Oil appears as a liquid and is not held by soil grains. Soils oozing petroleum typically contain approximately 2 to 3 percent petroleum.

Water sheen tests are conducted by placing a small aliquot of soil (about a tablespoon) into a cup or tray containing water, gently shaking, and watching for presence of petroleum sheen. Care will be taken to differentiate sheen created by petroleum (iridescent swirl of colors, does coalesce after being disturbed) versus other organic matter (angular "waxy" sheets, do not coalesce after being disturbed), and recording the information appropriately. The perceived magnitude of petroleum sheen (slight, moderate, heavy) will be recorded with corresponding odors if observed.

In addition to indications of tar or oil, other visual indicators of potential contamination that will be noted if observed include:

- Ashy material;
- Debris;
- Potential slag or clinker, as black, loose granular or shiny fused material; and
- Potential purifier wastes, as indicated by the presence of lime, dark and/or decomposed wood chips, iron filings and/or blue-staining that indicates the presence of cyanide.

The presence of many contaminants, particularly those without odors or volatile components (such as metals) or if present at very low levels, may not be readily apparent based on field screening and will require analytical testing to determine their presence/absence.

3.2.5 Incremental Sampling Methodology

The proposed locations of the DUs and the layout of the interior sampling grids will be established using ArcGIS 10 to allow field personnel to locate and stake out (as needed) the grid intersections within each DU using a portable global positioning (GPS) unit during sampling. Similarly, GIS will be used to generate random locations for each of the three replicate samples. The increment locations comprising each random replicate sample location will be located by field personnel using the GPS unit.

Increment samples will be obtained using direct-push drilling methods. Sampling rods fitted with 1-inch diameter disposable sleeves will be driven into the ground by pneumatic hammer, resulting in a continuous core sample of each vertical interval. Interval 1 increment samples will be collected from the ground surface, or just beneath any surface asphalt or concrete, to 3 feet. Interval 2 increment samples will be collected from 3 feet to 6 feet bgs. If there is no soil in either vertical interval at the increment sample location (because of the presence of a thick concrete slab occupying Interval 1, for example, or if there is poor soil recovery in either Interval), the drill rig will relocate to a contingent increment sample location located 3-feet north of the failed location, and resample. Field crews will repeat this procedure until a contingent location is found to be sampleable at both vertical intervals. All incremental samples from a single replicate and vertical interval within each DU will be placed together in a large wide-mouth glass jar (e.g., 64 ounce). A subset of the soil within each core, distributed continuously and approximately equally throughout each interval, will be collected to control sample volume.

All ISM samples will be double bagged and stored and transported in coolers with internal temperatures maintained at 4°C. Before 5 PM of each field day, sample coolers will be transported by field personnel to TestAmerica's Tacoma location under standard chain-of-custody procedures (discussed below). The laboratory will facilitate shipping of the ISM samples to the West Sacramento laboratory location for analysis.

3.2.5.1 Discrete Sampling Procedures for VOCs

GIS will be used to identify select ISM increment sample locations located at a frequency of approximately 250 ft² across each DU that will also be sampled for VOCs. In the selected sample locations, VOC samples will be obtained from soil in the direct-push sample rods immediately upon soil exposure (before collecting ISM samples), using laboratory-provided Terracore sampling kits and VOA containers in accordance with EPA Method 5035A.

All discrete VOC samples will be stored and transported in separate coolers from the ISM samples, with internal temperatures maintained at 4°C. Before 5 PM of each field day, sample coolers will be transported by field personnel to TestAmerica's Tacoma location under standard chain-of-custody procedures (discussed below). The discrete VOC samples will be analyzed at the Tacoma location.

3.2.5.2 Sample Equipment Decontamination

Sampling equipment for the chosen method (direct-push drilling) is generally disposable. Drill rig sample rods will be fitted with new, unused plastic sleeves for each increment, and incremental samples will be obtained from the sleeves by a clean gloved hand. Within an individual DU, any soil and mud adhered to reusable sampling equipment (such as the shoe and any hand tools used for separating the soil cores) will be wiped off the equipment prior to use at another incremental sampling location. Between DUs, all reusable sampling equipment or other field equipment (pin flags or stakes, etc.) will be washed in a 5-gallon bucket containing a Liqui-nox solution and double rinsed with deionized water. After air drying, sampling equipment will be wrapped in aluminum foil prior to use at the next DU, or departing the Site.

3.2.5.3 Field Activity and Sample Documentation

Documentation to be maintained by the field personnel include a daily field report that describes the field activities chronologically each day, photographs of the field activities, and sample documentation including sample labels and chain-of-custody forms.

Each sample container (Ziploc bag or VOAs) will be labeled with the following using permanent, non-volatile ink: unique sample identification, date, time, and project number. The unique sample identification format is “YYMM-XX-V” for which:

- YY is the year the sample was obtained;
- MM is the month the sample was obtained;
- XX is the two-digit DU number; and,
- V is the single-digit vertical interval number (surface to 3-feet as Interval 1 and 3-to 6-feet as Interval 2).

One chain-of-custody form will be completed for each sample cooler. Upon drop off at the TestAmerica Tacoma laboratory, each chain-of-custody form will be signed by a field representative and a laboratory representative. A copy of the signed form will be maintained by the field representative and included with the day's field report.

Discrete VOC samples will be logged at the Tacoma laboratory immediately following drop off, initiating the analysis process. For ISM samples, the Tacoma laboratory will facilitate shipping to the West Sacramento laboratory. Laboratory personnel will place the original chain-of-custody form inside a plastic bag in each cooler, and place signed and dated custody seals on each cooler, such that it is necessary to break the seal to open the cooler. The coolers will be sealed and shipped overnight. The integrity of the custody seals will be verified by the West Sacramento laboratory upon arrival, to ensure against sample tampering during shipment. West Sacramento laboratory personnel will log in the ISM samples upon receipt, and initiate the ISM process (described below).

All field and sample documentation will be completed in permanent ink and maintained by field personnel, even if they contain documentation errors that require correction. All corrections on field documentation will be made by a single strike line through the error, and a date and initial by the correction. Field and sample documents should be scanned and uploaded to the project site at the end of each field day.

3.2.5.4 Laboratory Processing and Analysis

Sample processing for discrete VOC samples will occur at TestAmerica's Tacoma laboratory. After the ISM samples are received by TestAmerica's West Sacramento laboratory, laboratory personnel will initiate the ISM processing. Sample processing for ISM samples by the laboratory will include air-drying, disaggregating, sieving, splitting, and subsampling according to TestAmerica's internal SOP for ISM sample processing, included as Attachment B.

Following the ISM processing, aliquots for analysis of metals, PCBs, and chlorinated pesticides will be tested at the West Sacramento laboratory. Aliquots for analysis of SVOCs and cyanide will be packaged and shipped overnight to TestAmerica's Seattle laboratory for testing. Additional aliquots will be archived at the West Sacramento laboratory for potential analysis of dioxin/furans. If PCBs, chlorinated phenols, or chlorinated pesticides are detected above PRGs in a replicate sample, the corresponding archived aliquot will be analyzed for dioxins/furans.

3.2.6 Soil Analytical Approach

This section presents a detailed soil analytical approach for the Source Characterization (Section 3.1.4) and general soil analytical approach for the Source Areas Investigation (Section 3.1.5) and the Outside Source Areas Investigation (Section 3.1.6). The analytical approach for the Source Areas Investigation and Outside Source Areas Investigation will be refined as work progresses to meet the objectives presented in the Final RI/FS Work Plan.

Table A-4 summarizes the general sampling and analysis approach for each phase of the investigation. The method, container, and preservation requirements for each laboratory analysis are provided on Table A-5. QC soil samples (e.g., field duplicates, rinsate blanks, and trip blanks) will be collected at the respective frequencies prescribed in Section A3.5 of the QAPP.

3.2.6.1 Source Characterization

The primary analytical objective of the Source Characterization is to evaluate the COPCs associated with each identified source or source area. In general, samples collected for analysis during the source characterization will be analyzed for the full suite of COPCs⁵ to

⁵As described in Section 3.2.5, samples exhibiting high levels of contamination that are likely to cause analytical interferences or instrumentation problems may not be analyzed for all analytes. For example, samples of potential tarry materials would not be analyzed for pesticides.

determine the composition of potential source materials, except for dioxins/furans, whose presence will be analyzed for in a subset of samples where PCBs, chlorinated phenols, or chlorinated pesticides are detected above reporting limits.

At least one representative sample of each distinct source material will be collected for chemical analysis. Additionally, soil samples will be collected to define the vertical extent of source material. A source will be considered vertically delineated when field observations no longer indicate gross visible contamination, strong odors, or significantly elevated PID readings. Assuming borings will be advanced to 16 feet bgs, at least two soil samples will be collected from beneath each source as follows:

- One sample less than 2 feet below the source.
- One sample between 2 and 6 feet below the source.

Additional samples will be collected at 4-foot intervals to a maximum depth of 16 feet bgs, which is the assumed depth of drilling achievable using direct-push methodology. If collection of two samples beneath the source is not possible with direct-push borings, then additional drilling methods will be used to obtain at least two samples up to 6 feet beneath the source.

3.2.6.2 Source Areas Investigation

Soil samples will be collected during the Source Areas Investigation to evaluate the extent of soil contamination downgradient of Source Areas. Transects of deep borings will be advanced perpendicular to groundwater flow, immediately downgradient of each Source Area. The primary objective of the borings is to identify the location for construction of a monitoring well. However, soil samples will be collected from each transect as follows:

- One soil sample will be collected from fill material, either at the highest degree of contamination observed at the time of drilling, or at a depth corresponding to the depth of the source in the fill material.
- One soil sample will be collected from the native soils in the vadose zone, either at the highest degree of contamination observed at the time of drilling, or at a depth corresponding to the depth of the source in the native, vadose zone soils.
- One soil sample will be collected from each saturated unit and aquitard encountered in the transect borings.

The soil samples will be analyzed for all Site COPCs except dioxins/furans. Samples for potential dioxin/furan analysis will be archived, and archived samples will be analyzed for dioxins/furans if PCBs, chlorinated phenols, or chlorinated pesticides are detected.

3.2.6.3 Outside Source Areas Investigation

The soil samples to be analyzed as part of the Outside Source Areas Investigation will be those collected via ISM as described in detail in Section 3.2.5.

3.2.7 Monitoring Well Installation Development

Monitoring wells will be constructed by a state-licensed, resource protection well driller and in accordance with Chapter 173-160 WAC. All monitoring wells will be constructed with 2-inch-diameter threaded Schedule 40 PVC slotted screen and blank casing. Well screens will be 0.010-inch (10 slot) slotted screen. An artificial filter pack consisting of 10/20 silica sand will be placed around the well screen, and an annular seal consisting of bentonite chips will be placed above the filter pack. A concrete surface seal will be set at grade for each new monitoring well. The finished monitoring wells will be protected with a steel flush-mount monument, or steel above-ground monument, embedded in the concrete surface seal.

An Aspect field geologist will oversee and document installation of each monitoring well, including completion of an As-Built Well Completion Diagram. Well casing diameter, screen length and total depth are dependent on the purpose of the well and the lithology observed during the investigation activities. The general design and construction of the wells will follow Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers, American Society for Testing and Materials (ASTM) Standard D5092 (ASTM, 2010), and Minimum Standards for Construction and Maintenance of Wells, Chapter 173-160 WAC (WAC, 2008).

Following installation, each new monitoring well will be developed to remove fine-grained material from inside the well casing and filter pack to the extent practical, and to improve hydraulic communication between the well screen and the surrounding water-bearing formation. Depth to water will be measured at start and end of development. The wells will be developed using an inertial pump and surge block by performing surge and pump cycles until the water is substantially clear. Surging over the length of the screened interval will be performed for a set period or a minimum of 10 surges. The well will then be pumped until the water clears significantly. These surge and pump cycles will be repeated until the water is substantially clear shortly after the start of pumping or until a maximum of 15 casing volumes of water has been removed.

3.2.8 Groundwater Data Collection

Groundwater samples will be collected from the monitoring wells and handled in accordance with the procedures described below.

- The locking well cap will be removed and the depth-to-groundwater will be measured from the surveyed location to the nearest 0.01 foot using an electronic water level measuring device. The depth to the bottom of the monitoring well will also be measured to evaluate siltation of the monitoring well. The water level indicator will be decontaminated between wells.
- Each monitoring well will be purged at a low-flow rate less than 0.5 liter per minute (Puls and Barcelona, 1996) using a dedicated electric submersible or bladder pump. The tubing intake will be placed just below the center of the saturated section of well screen.

- During purging, field parameters (temperature, pH, specific electrical conductance, dissolved oxygen, and oxidation-reduction potential [ORP]) will be monitored using a YSI meter and flow-through cell, or equivalent. These field parameters will be recorded at 3-minute intervals throughout well purging until they stabilize. Stabilization is defined as three successive readings where the parameter values vary by less than 10% (or 0.5 milligrams per liter [mg/L] dissolved oxygen if the readings are below 1 mg/L). However, no more than three well casing volumes will be purged prior to groundwater sample collection. Three turbidity measurements will also be made before collecting the sample (Hach 2100Q turbidimeter). Samples with a field-measured specific electrical conductance greater than 1,000 $\mu\text{S}/\text{cm}$ or turbidity greater than 25 nephelometric turbidity units (NTU) will be denoted as such on the chain-of-custody form, so that the laboratory can employ appropriate sample preparation techniques).
- If the monitoring well is completely dewatered during purging, samples will be collected when sufficient recharge has occurred to allow filling of all sample containers.
- Once purging is complete, the groundwater samples will be collected using the same low-flow rate directly into laboratory-supplied sample containers. Samples for dissolved metals analyses will be field filtered using an in-line 0.45 μm filter; at least 0.5 liter of water will be purged through the filter prior to sample collection.

QC groundwater samples (e.g., field duplicates and trip blanks) will be collected at the respective frequencies prescribed in Section 3.5.

Following sampling, the wells cap and monument cap will be secured. Each well's dedicated tubing will be retained in a labeled Ziploc bag for subsequent sampling events. Any damaged or defective well caps or monuments will be noted and scheduled for replacement, if necessary.

3.2.9 Groundwater Analytical Approach

The data collection for the RI/FS will include at least four consecutive quarterly groundwater monitoring and sampling events. The first sampling event conducted will include all existing and newly installed monitoring wells and consist of the collection and laboratory analysis of groundwater samples for VOCs, SVOCs, cyanide, metals and PCBs. The preliminary groundwater analytical approach is described on Table A-4. Wells will also be analyzed for conventional parameters (dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, calcium, sodium, potassium, magnesium, chloride, ferrous iron, dissolved manganese, and alkalinity) as noted in Table A-4. Following the first event, the soil and groundwater data will be reviewed collectively to determine the scope of work for additional sampling events. The scope and frequency of subsequent groundwater monitoring will be determined in consultation with EPA.

The method, container, and preservation requirements for each laboratory analysis are provided on Table A-5. QC groundwater samples (e.g., field duplicates, rinsate blanks, and trip blanks) will be collected at the respective frequencies prescribed in Section 3.5 of the QAPP.

3.2.10 Hydrogeologic Data Collection

3.2.10.1 Hydraulic Conductivity Testing

A common method of in situ estimation of the hydraulic conductivity is the slug test. This method consists of quickly lowering or raising the water level in a well or borehole from equilibrium and measuring its subsequent rate of rise or fall, respectively. The slug test method is an efficient, cost-effective method to estimate the hydraulic conductivity of the hydrogeologic unit in which a particular well is completed.

3.2.10.1.1 Field Procedures

Prior to slug testing, the wells will be fully developed. Any wells where the turbidity exceeds 50 NTUs will be redeveloped.

The slug tests produce a change in water level within a well and measure the rate of return to the static water level. This rate of water level change in the well is used to compute the hydraulic conductivity of the water bearing zone. Depending on the location of the monitoring well screen relative to the water table, either a slug bar or a pneumatic slug apparatus will be used to induce a water level change in the well. For monitoring wells with unsaturated or partially saturated screens, wells where the water table is less than 3 feet above the top of the screen, or for wells where the casing will not hold pressure; a slug bar of known volume will be used to displace water. For monitoring wells with fully saturated screens where the water level is greater than 3 feet above the top of the screen; a pneumatic slug apparatus will be used to displace water. For either test method, the displacement volume (size of the slug bar or the operating pressure of the pneumatic apparatus) will be chosen based on the expected hydraulic conductivity of the screened aquifer interval.

To test the results for dependency of hydraulic head, slug tests will be performed using a minimum of two different displacement volumes at each well. To test for repeatability, a minimum of two slug tests will be performed at each displacement volume.

3.2.10.1.2 Slug Bar Testing Methods

Slug bars will be one inch in diameter to allow passage of the transducer cable inside a standard 2 inch diameter well casing. Slug bar lengths of 1.3, 2.6, or 5.0 feet will be used to produce approximately 0.5, 1.0, or 2.0 feet of displacement in a 2 inch monitoring well; respectively.

The water level in the well will be measured using a vented pressure transducer (5 or 15psi range) and collected electronically on a data logger set to a nearly continuous time interval (0.1 second data logging frequency). Manually collected water level measurements, taken

periodically throughout the test with a water level indicator, will be used to confirm results collected from the pressure transducer. Prior to the testing, the pressure transducer will be installed to avoid contact with the slug bars. Once the transducer is in place and the data logger is programmed, the slug bar will be lowered on a line until it is just above water — as evidenced by change in monitored pressure reading when bottom of slug bar enters water or by a level indicator lowered with the slug.

Falling Head Test. To initiate the falling head test, the slug bar will be dropped into the groundwater so it is fully submerged. The insertion should be done quickly, and with care taken not to disturb the pressure transducer. Water in the well will rapidly rise, then slowly fall to meet the initial static water level over time. The pressure will be monitored to confirm initial displacement was relatively instantaneous compared to the response. When the pressure transducer indicates that water levels have recovered 80 percent (for low-K formations) to 95 percent (for high-K formations) of the initial displacement, the test will be concluded, at which time the water level will be confirmed manually.

Rising Head Test. At the completion of the each falling head test, the slug bar is fully submerged and the water level has returned to near static conditions. The rising head test will be initiated at this time by quickly raising the slug bar will completely out of water without disturbing the pressure transducer. Water in the well will rapidly fall and then rise to meet the initial static water level over time. The pressure will be monitored to confirm initial displacement was relatively instantaneous compared to the response. When the pressure transducer indicates that water levels have recovered 80 percent (for low hydraulic conductivity formations) to 95 percent (for high hydraulic conductivity formations) of the initial displacement, the test will be concluded, at which time the water level will be confirmed manually.

3.2.10.1.3 Pneumatic Testing Methods

The pneumatic slug apparatus creates an airtight seal with the well casing and uses compressed nitrogen to displace water in the well casing. The apparatus consists of the following items:

- 22 cubic foot compressed nitrogen bottle with primary regulator and secondary 0-10 psi low pressure regulator; and
- PVC wellhead assembly with pressure relief valve, analog pressure gauge (0-100 inches of water range), pressure transducer cable compression fitting, and flexible rubber PVC coupling.

Similar to the slug bar testing method, the water level in the well will be measured using a vented pressure transducer (5 or 15psi range) and collected electronically on a data logger set to a nearly continuous time interval (0.1 second data logging frequency).

Rising Head Test. The pneumatic slug test is initiated by closing the pressure relief valve and slowly adjusting the low pressure regulator to the desired pressure (displacement). Pressures of 6, 12, and 24 inches of water correspond to water level displacements of approximately 0.5, 1.0, or 2.0 feet; respectively. As the headspace in the well is being

pressurized and the water level is equilibrating, the pressure transducer will read an elevated pressure. Following equilibration of the water level, the pressure transducer reading will be consistent with pre-test readings. After the transducer readings have stabilized, the pressure relief valve is then opened quickly to allow the water level in the well to return to static conditions. The valve should be opened quickly without disturbing the pressure transducer. When the pressure transducer indicates that water levels have recovered 80% (for low hydraulic conductivity formations) to 95% (for high hydraulic conductivity formations) of the initial displacement, the test will be concluded.

Falling Head Test. The pneumatic slug testing apparatus does not support falling head slug testing. The initial pressurization of the well casing is functionally equivalent to a falling head test. Equilibration time is dependent on hydraulic conductivity, and the equilibration time of a given pressure (displacement) will be equivalent to the recovery time for a rising head test.

3.2.10.1.4 Data Analysis

The recovery data of the slug tests will be used to estimate the hydraulic conductivity of the formation adjacent to screened interval of each monitoring well through the comparison of theoretical models. Theoretical models such as Hvorslev (1951), Cooper et al. (1967), Bouwer and Rice (1976), and Dagan (1978) will be used for typical water level recovery curves. In the event that inertial effects or oscillatory water level responses are observed, the theoretical model of Springer-Gelhar (1991) shall be used when applicable in high hydraulic conductivity formations. The appropriate model for each well will be determined after data is plotted and inspected. The use of a curve-matching computer software program may be used for effective analysis. Potential well skin effects will be assessed using methods described in Butler (1996).

3.2.10.2 Tidal Study

A tidal study will be conducted to evaluate effects of tidal fluctuations on nearshore groundwater levels, and thus flow direction, throughout the tidal cycle. The tidal study will involve collection of continuous water level measurements over a 72- to 96-hour period at select monitoring wells. The tidal study will include wells screened at the water table and in all deeper water-bearing zones that are identified and in which wells are constructed. Where present, monitoring wells located at varying distances from the shoreline along a flow path will be used in the tidal study to evaluate tidal influence on groundwater with distance from the shoreline.

Each of the wells will be equipped with a downhole pressure transducer/data logger to allow automated collection of water level data at 5-minute intervals. A data logger will also be placed in the Port Washington Narrows to directly record tidal fluctuations. A barometric pressure data logger will also be installed to allow water level data to be corrected for changes in atmospheric pressure throughout the study. During installation of the data loggers, a manual depth-to-water measurement will be collected in each well when the data logger takes its first reading, and again at the end of the test prior to removing the logger. The depth-to-water measurements (below surveyed top of well casing) provide groundwater elevations which will be used to convert the data logger

readings into groundwater elevations. A round of concurrent water level measurements will also be collected in all upland wells during the tidal study.

The tidal data from each well will be analyzed using the method of Serfes (1991) to derive a tidally-averaged groundwater elevation for the study period. The data from the wells will be used to assess the net (tidally averaged) groundwater flow direction and hydraulic gradients. Aquifer hydraulic conductivity will be estimated from the tidal study data using the stage ratio and time lag methods of Ferris (1963).

3.3 Sample Handling Requirements

This section addresses the sampling program requirements for field decontamination, investigation-derived waste management, sample custody, and sample shipping requirements.

3.3.1 Sample Handling Procedures

Soil and groundwater samples collected for chemical analysis will be placed in appropriately sized, laboratory prepared, pre-cleaned, labeled sample containers and capped with Teflon®-lined lids (Table A-5).

Each sample label will contain the project name, sample ID, preservation technique (where applicable), date and time of collection, and the initials of the person(s) preparing the sample. A completed sample label will be affixed to each sample container.

3.3.2 Decontamination Procedures

All nondisposable sampling equipment (stainless steel spoons and bowls) will be decontaminated before collection of each sample. The decontamination sequence consists of a scrub with a nonphosphate (Alconox) solution, followed by tap water (potable) rinse, and finished with thorough spraying with deionized or distilled water. A solvent rinse—methanol or hexane—may be used to remove petroleum product from sampling equipment prior to the decontamination procedure described above.

3.3.3 Field-generated Waste Disposal

The investigation and sampling methods described in this SQAPP will generate the following investigation-derived waste (IDW):

- Soil and drilling cuttings;
- Groundwater (development and purge water);
- Decontamination water;
- Personal protective equipment (PPE); and
- Disposable sampling equipment (dedicated samplers, tubing, etc.).

All IDW will be segregated by media (soil/solid, liquid, and refuse [PPE and disposables]) and placed in labeled Washington State Department of Transportation (DOT)-approved

drums pending the analytical results to determine appropriate disposal. Each drum will be labeled with the following information:

- Nonclassified IDW;
- Content of the drum (soil, water, PPE) and its source (i.e., the exploration[s] from which the contents came);
- Date IDW was generated; and
- Name and telephone number of the contact person.

The drums of IDW will be temporarily consolidated on-Site, profiled (in accordance with applicable waste regulations) based on available analytical data, and disposed of appropriately at a permitted off-site disposal facility. Containers of IDW will be on-Site less than 90 days from date of generation. EPA will be notified prior to the shipment of any materials to an off-Site disposal location. This notification will include the identification of the proposed off-Site disposal facility.

Documentation for off-Site disposal of IDW will be maintained in the project file.

3.3.4 Shipping Requirements and Chain-of-Custody

Upon collection, samples will be placed upright in a cooler. Ice or blue ice will be placed in each cooler to meet sample preservation requirements. Inert cushioning material will be placed in the remaining space of the cooler as needed to limit movement of the sample containers. If the sample coolers are being shipped, not hand carried, to the laboratory, the chain-of-custody form will be placed in a waterproof bag taped to the inside lid of the cooler for shipment.

After collection, samples will be maintained in Aspect's custody until formally transferred to the analytical laboratory. For purposes of this work, custody of the samples will be defined as follows:

- In plain view of the field representatives;
- Inside a cooler that is in plain view of the field representative; or
- Inside any locked space such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s).

A chain-of-custody record provided by the laboratory will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the chain-of-custody form; however, shipping receipts will be collected and maintained as a part of custody documentation in project files. A copy of the chain-of-custody form with appropriate signatures will be kept by Aspect's project manager.

All samples will be shipped or hand-delivered to the analytical laboratory no later than the day after collection. Samples collected on Friday may be held until the following Monday for shipment, provided that this does not jeopardize any hold time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container holding the samples for analysis will be hand-delivered the day of sample collection, couriered, or shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the field coordinator will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of containers shipped and the airbill tracking numbers for those containers.
- Coolant ice will be sealed in separate plastic bags and placed in the shipping containers.
- Individual samples will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
- If the samples are transferred using a commercial shipping company, the following procedures will be followed:
 - The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
 - The shipping waybill number will be documented on all chain-of-custody forms accompanying the samples.
 - Chain-of-custody forms will be enclosed in a plastic bag and placed inside the cooler.
 - A minimum of two signed and dated chain-of-custody seals will be placed on adjacent sides of each cooler prior to shipping.
 - Each cooler will be wrapped securely with strapping tape, labeled "Glass – Fragile" and "This End Up," and be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the person receiving the sample will sign the chain-of-custody form. The shipping container seals will be broken (if applicable) and the receiver will record the condition of the samples on a sample receipt form. Chain-of-custody forms will be used internally in the lab to track sample handling and final disposition.

3.4 Laboratory Methods

This section summarizes the target physical and chemical analyses for the soil and groundwater samples to be collected during the upland portion of the RI. All sample analyses will be conducted in accordance with EPA-approved methods and this Upland SQAPP. Prior to analyses, all samples will be maintained per the appropriate holding times and temperatures for each analysis (Table A-5). Analytes, analytical methods, and target detection limits for chemical and physical testing are presented in Tables A-2 and A-3.

Except as described in Section 3.2.5 for ISM, all chemical/physical testing will be conducted at Friedman & Bruya, Inc. and Analytical Resources, Inc. Both laboratories are accredited under the National Environmental Laboratories Accreditation Program. All chemical and physical testing will adhere to the most recent EPA QA/QC procedures outlined in the approved analytical methods and in this Upland SQAPP. If more current analytical methods are available, the laboratories will use them. The laboratories have provided a list of practical method reporting limits for each analyte of interest, which are summarized on Tables A-2 and A-3.

The analytical methodologies to be employed for the analyses of samples collected during the RI/FS are in accordance with the following documents:

- USEPA SW Methods – USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, December 1996.
- USEPA Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, Office of Water, U.S. Environmental Protection Agency, August 2002, EPA-821-R-02-019.
- Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 20th Edition, 1995.
- Ecology Analytical Methods for Petroleum Hydrocarbons. Publication No. ECY 97-602. June 1997.

Table A-5 lists the laboratory analytical methods for soil and groundwater analyses to be performed during the RI/FS, along with samples containers, preservation, and analytical holding times for each analysis.

3.5 Quality Assurance/Quality Control

3.5.1 Field Quality Control

Beyond use of standard sampling protocols defined in this Upland SQAPP, field QC procedures include maintaining the field instrumentation used. Field instruments (e.g., PID for evaluating presence of VOCs in soil samples, and the YSI meter for measuring field parameters during groundwater sampling) are maintained and calibrated regularly prior to use, in accordance with manufacturer recommendations.

In addition, field QC samples will be collected and submitted for analyses to monitor the precision and accuracy associated with field procedures. Field QC samples to be collected and analyzed for this RI include field duplicates, trip blanks, and equipment rinsate blanks. The definition and sampling requirements for field QC samples are presented below.

Blind Field Duplicates. Blind field duplicate samples are used to check for sampling and analysis reproducibility; however, the field duplicate sample results include variability introduced during both field sampling and laboratory preparation and analysis, and EPA data validation guidance provides no specific evaluation criteria for field duplicate samples. Advisory evaluation criteria are set forth at 35% for RPD (if both results are greater than 5 times the RL) and 2 times the RLs for concentration difference (if either of the result is less than 5 times the RL) between the original and field duplicate results.

Field Duplicates will be submitted “blind” to the laboratory as discrete samples (i.e., given unique sample identifiers to keep the duplicate identity unknown to the laboratory), but will be clearly identified in the field log. Field duplicate samples will be collected at a frequency of 5% (1 per 20) of the field samples for each matrix and analytical method, but not less than one duplicate per sampling event per matrix.

If a given soil sample depth interval lacks sufficient volume (recovery) to supply material for a planned analysis and its field duplicate analysis, the field duplicate aliquot will be collected for that analysis from another depth interval in that same location if practical.

Trip Blank Samples. Trip blank samples will be used to monitor possible VOC cross contamination occurring during sample transport. Trip blank samples are prepared and supplied by the laboratory using organic-free reagent-grade water into a VOC vial prior to the collection of field samples. The trip blank sample vials are placed with and accompany the VOC and gasoline-range total petroleum hydrocarbon (TPH) samples through the entire transporting process. One trip blank will be collected for each soil sampling round and each groundwater sampling round where VOC or gasoline-range TPH analyses are conducted.

In case a target compound is present in a trip blank, results for all samples shipped with this trip blank will be evaluated and data qualified accordingly if determined that the results are affected.

Equipment Rinsate Blank Samples. Equipment rinsate blanks are collected to determine the potential of cross-contamination introduced by soil sampling equipment that is used between samples. Groundwater sampling is conducted using dedicated equipment; therefore, rinsate blanks are not needed for groundwater sampling QC. The deionized water used for soil sampling equipment decontamination is rinsed through the decontaminated sampling equipment and collected into adequate sample containers for analysis of VOCs, low-level PAHs, and priority pollutant metals. The blank is then processed, analyzed, and reported as a regular field sample. One rinsate blank will be conducted for each round of soil sampling. The rinsate blank sampled will be labeled with a “RB-“ prefix and the date it is collected (e.g., RB-053015).

3.5.2 Laboratory Quality Control

The laboratories' analytical procedures must meet requirements specified in the respective analytical methods or approved laboratory standard operating procedures (SOPs), e.g., instrument performance check, initial calibration, calibration check, blanks, surrogate spikes, internal standards, and/or labeled compound spikes. Specific laboratory QC analyses required for this project will consist of the following at a minimum:

- Instrument tuning, instrument initial calibration, and calibration verification analyses as required in the analytical methods and the laboratory standard operating procedures (SOPs);
- Laboratory and/or instrument method blank measurements at a minimum frequency of 5% (1 per 20 samples) or in accordance with method requirements, whichever is more frequent; and
- Accuracy and precision measurements as defined in Table A-1, at a minimum frequency of 5% (1 per 20 samples) or in accordance with method requirements, whichever is more frequent. In cases where a pair of MS/MSD or MS/laboratory duplicate analyses are not performed on a project sample, a set of LCS/LCSD analyses will be performed to provide sufficient measures for analytical precision and accuracy evaluation.

The laboratory's QA officers are responsible for ensuring that the laboratory implements the internal QC and QA procedures detailed in their Quality Assurance Manual.

3.6 Field Instrument/Equipment Calibration

Maintenance and calibration of instruments used in the field for sampling (e.g., PID for evaluating presence of VOCs in soil samples, and the YSI meter for measuring field parameters during groundwater sampling) will be conducted regularly in accordance with manufacturer recommendations prior to use. The Aspect field coordinator will be responsible for verifying that required maintenance has been performed prior to using equipment in the field. Equipment maintenance and calibration information will be documented in the instrument's calibration log. Detailed information regarding the calibration procedures and frequency of equipment calibration is provided in each specific manufacturers instruction manual.

3.7 Inspection/Acceptance of Supplies and Consumables

Inspection and acceptance of field supplies, including laboratory-prepared sampling bottles, will be performed by the field coordinator. All primary chemical standards and standard solutions used for this project, either in the field or laboratory, will be traceable to documented, reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

3.8 Data Management

Daily field records, a combination of field logbooks, field forms and chain-of-custody forms, will make up the primary documentation for field activities. The daily field records will be checked for completeness and accuracy by the field coordinator. Upon completion of review, hard copy notes and forms will be scanned to create an electronic record of the daily field activities. Information pertaining to sampling locations, dates, depths, equipment and the sample identifiers will be entered into the project database. All manually-entered data will be reviewed and verified by a second party.

Laboratory data will be provided to the Data Manager in the EQuIS electronic format. Laboratory data that is electronically provided and loaded into the database will undergo a check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of all manually-entered data will be verified by a second party. Data tables and reports will be exported from EQuIS to Microsoft Excel tables.

4 Assessments and Response Actions

Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

4.1 Compliance Assessments

Laboratory and field performance audits consist of on-Site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study; however, all laboratory audit reports will be made available to the project QA/QC Manager upon request. The laboratory is required to have written procedures addressing internal QA/QC; these procedures have been submitted and will be reviewed by the project QA/QC Manager to ensure compliance with the QAPP. The laboratory must ensure that personnel engaged in sampling and analysis tasks have appropriate training. The laboratory will, as part of the audit process, provide for consultant's review of written details of any and all method modifications planned.

4.2 Response and Corrective Actions

The following paragraphs identify the responsibilities of key project team members and actions to be taken in the event of an error, problem, or nonconformance to protocols identified in this document.

4.2.1 Field Activities

The field coordinator will be responsible for correcting equipment malfunctions during field sampling activities. The project manager will be responsible for resolving situations identified by the field coordinator that may result in non-compliance with the SQAPP. All corrective measures will be documented in the field logbook.

4.2.2 Laboratory

The laboratory is required to comply with their SOPs. The Laboratory Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If routine QC audits by the laboratory result in detection of unacceptable conditions or data, actions specified in the laboratory SOPs will be taken. Specific corrective actions are outlined in each SOP used and can include the following:

- Identifying the source of the violation;
- Reanalyzing samples if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and/or

- Accepting but qualifying data to indicate the level of uncertainty.

If unacceptable conditions occur, the laboratory will contact Aspect's project manager to discuss the issues and determine the appropriate corrective action. Corrective actions taken by the laboratory during analysis of samples for this project will be documented by the laboratory in the case narrative associated with the affected samples.

In addition, the project data quality manager will review the laboratory data generated for this investigation to ensure that project DQOs are met. If the review indicates that non-conformances in the data have resulted from field sampling or documentation procedures or laboratory analytical or documentation procedures, the impact of those non-conformances on the overall project data usability will be assessed. Appropriate actions, including re-sampling and/or re-analysis of samples may be recommended to the project manager to achieve project objectives.

4.3 Reports to Management

Corrective actions will be required if deviations from the methods or QA requirements established in this SQAPP are encountered. The project manager will provide assistance in resolving the issue and corrective actions will be taken immediately, if possible. Any issue that ultimately affects the quality of the data, or results in a change of scope in the work described in the SQAPP will be documented in the field logbook. A description of the issue, the attempted resolution, and any effects on data quality or usability will be provided in the data report submittal.

5 Data Validation and Usability

This section describes the processes that will be used to review project quality data.

5.1 Data Review, Validation, and Verification

During the validation process, analytical data will be evaluated for method quality control and laboratory quality control compliance, and their validity and applicability for program purposes will be determined. All data will undergo a 90% Stage 2B and 10% Stage 4 data validation. Based on the findings of the validation process, data validation qualifiers may be assigned. The validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved, as needed.

5.2 Validation and Verification Methods

Data validation includes signed entries by the field and laboratory technicians on field data sheets and laboratory datasheets, respectively; review for completeness and accuracy by the FC and Laboratory Manager; review by the Data Manager for outliers and omissions; and the use of QC criteria to accept or reject specific data. All data will be entered into the EQuIS database and a raw data file printed. Ten percent verification of the database raw data file and one hundred percent verification of assigned qualifiers will be performed by a second data manager or designee. Any errors found will be corrected on the raw data printout sheet. After the raw data is checked, the top sheet will be marked with the date the checking is completed and the initials of the person doing the checking. Any errors in the raw data file will be corrected, and the database established.

All laboratory data will be reviewed and verified to determine whether all DQOs have been met, and that appropriate corrective actions have been taken, when necessary. The project QA/QC Manager or designee will be responsible for the final review of all data generated from analyses of samples.

The first level of review will take place in the laboratory as the data are generated. The laboratory department manager or designee will be responsible for ensuring that the data generated meet minimum QA/QC requirements and that the instruments were operating under acceptable conditions during generation of data. DQOs will also be assessed at this point by comparing the results of QC measurements with pre-established criteria as a measure of data acceptability.

The analysts and/or laboratory department manager will prepare a preliminary QC checklist for each parameter and for each sample delivery group (SDG) as soon as analysis of an SDG has been completed. Any deviations from the DQOs listed on the checklist will be brought to the attention of the Laboratory Manager to determine whether corrective action is needed and to determine the impact on the reporting schedule.

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality

will be assessed by a reviewer using current CLP NFG data validation requirements (EPA 1999; EPA 2002) by considering the following:

- Holding times
- Initial calibrations
- Continuing calibrations
- Method blanks
- Surrogate recoveries
- Detection limits
- Reporting limits
- Laboratory control samples
- MS/MSD samples
- Standard reference material results

The data will be validated in accordance with the project specific DQOs described above, analytical method criteria, and the laboratory's internal performance standards based on their SOPs.

5.3 Reconciliation with User Requirements

The QA/QC Manager will review data to determine if DQOs have been met. If data do not meet the project's specifications, the QA/QC Manager will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors, and will suggest corrective action. It is expected that the problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies/equipment; if not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA/QC Manager will recommend appropriate modifications. Any revisions will require approval by EPA. If matrix interference is suspected to have attributed to the exceedance, adequate lab documentation must be presented to demonstrate that instrument performance and/or laboratory technique did not bias the result. In cases where the DQOs have been exceeded and corrective actions did not resolve the outlier, data will be qualified per CLP NFG (EPA 1999, 2004). In these instances, the usability of the data will be determined by the extent of the exceedance.

6 References

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U.S. Environmental Protection Agency (EPA), 2013, Administrative Order on Consent (AOC) for Remedial Investigation Feasibility Study, Bremerton Gas Works Site, EPA Region 10, 2013.

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TABLES

Table A-1. Measurement Quality Control Indicators

Bremerton Gas Works Superfund Site

Bremerton, Washington

Measurement Quality Indicators	QC Parameters
Precision	RPD values of:
	(1) LCS/LCS Duplicate
	(2) MS/MSD
	(3) Field Duplicates
Accuracy/Bias	Percent Recovery (%R) or Percent Difference (%D) Values of:
	(1) Initial Calibration and Calibration Verification
	(2) LCS
	(3) MS
	(4) Surrogate Spikes
	Results of:
	(1) Instrument and Calibration Blank
	(2) Method (Preparation) Blank
	(3) Trip Blank
	(4) Equipment Rinsate Blank
Representativeness	Results of All Blanks
	Sample Integrity (CoC and Sample Receipt Forms)
	Holding Times
Comparability	Sample-specific Reporting Limits
	Sample Collection Methods
	Laboratory Analytical Methods
Completeness	Data Qualifiers
	Laboratory Deliverables
	Requested/Reported Valid Results
Sensitivity	MDLs and MRLs

Notes:

LCS = Laboratory Control Sample

MDL = Method Detection Limit

MRL = Method Reporting Limit

MS/MSD = Matrix Spike/Matrix Spike Duplicate

Table A-2. Measurement Quality Objectives for Soil Samples

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte Name	MDL ⁽¹⁾	MRL	LCS/LCS %R ^(A)	MS/MSD %R ^(A)	RPD (%)	Surrogate %R ^(A)	Initial PRGs
Cyanide, Total by EPA 9014 (mg/kg)							
Cyanide	0.03	0.05	75 - 120	75 - 125	20	n/a	2.3
Total Organic Carbon by Plumb 1981 (%)							
Total Organic Carbon	n/a	0.200	75 - 120	75 - 125	20	n/a	n/a
Metals by EPA 200.8 (mg/kg)							
Antimony	0.100	0.200	75 - 125	80 - 120	20	n/a	0.27
Arsenic	0.250	0.500	75 - 125	80 - 120	20	n/a	0.68
Beryllium	0.100	0.200	75 - 125	80 - 120	20	n/a	16
Cadmium	0.0500	0.100	75 - 125	80 - 120	20	n/a	0.36
Chromium	0.250	0.500	75 - 125	80 - 120	20	n/a	26
Chromium VI (soluble)	0.0907	1.0	75 - 125	80 - 120	20	n/a	0.3
Cobalt	0.100	0.200	75 - 125	80 - 120	20	n/a	2.3
Copper	0.250	0.500	75 - 125	80 - 120	20	n/a	28
Lead	0.0500	0.100	75 - 125	80 - 120	20	n/a	11
Manganese	0.250	0.500	75 - 125	80 - 120	20	n/a	180
Nickel	0.500	0.500	75 - 125	80 - 120	20	n/a	38
Selenium	0.250	0.500	75 - 125	80 - 120	20	n/a	0.52
Silver	0.100	0.200	75 - 125	80 - 120	20	n/a	4.2
Thallium	0.100	0.200	75 - 125	80 - 120	20	n/a	0.078
Zinc	2.00	4.00	75 - 125	80 - 120	20	n/a	46
Mercury by EPA 7471B (mg/kg)							
Mercury	0.0125	0.025	75 - 125	80 - 120	20	n/a	1.1
Volatile Organic Compounds (VOCs) by SW8260C (ug/kg)							
1,1,1,2-Tetrachloroethane	0.233	1.00	80 - 120	80 - 120	30	n/a	2000
1,1,1-Trichloroethane	0.226	1.00	78 - 133	78 - 133	30	n/a	8.10E+05
1,1,2,2-Tetrachloroethane	0.253	1.00	71 - 120	71 - 120	30	n/a	600
1,1,2-Trichloroethane	0.286	1.00	77 - 120	77 - 120	30	n/a	150
1,1,2-Trichlorotrifluoroethane (Freon 113)	0.287	2.00	72 - 142	72 - 142	30	n/a	4.00E+06
1,1-Dichloroethane	0.203	1.00	65 - 139	65 - 139	30	n/a	3600
1,1-Dichloroethene	0.336	1.00	73 - 138	73 - 138	30	n/a	23000
1,2,3-Trichlorobenzene	0.305	5.00	76 - 122	76 - 122	30	n/a	6300
1,2,3-Trichloropropane	0.517	2.00	75 - 120	75 - 120	30	n/a	5.1
1,2,4-Trimethylbenzene	0.230	1.00	77 - 125	77 - 125	30	n/a	5800
1,2-Dibromo-3-chloropropane	0.586	5.00	61 - 128	61 - 128	30	n/a	5.3
1,2-Dichloroethane	0.191	1.00	77 - 120	77 - 120	30	n/a	460
1,2-Dichloroethene, cis-	0.240	1.00		75 - 124	30	n/a	1.60E+04
1,2-Dichloroethene, trans-	0.266	1.00	73 - 131	73 - 131	30	n/a	1.60E+05
1,2-Dichloropropane	0.162	1.00	74 - 120	74 - 120	30	n/a	1000
1,3,5-Trimethylbenzene (Mesitylene)	0.254	1.00	77 - 126	77 - 126	30	n/a	7.80E+04
1,3-Dichloropropane	0.209	1.00	77 - 120	77 - 120	30	n/a	1.60E+05
1,3-Dichloropropene, cis-	0226	1.00	80 - 124	80 - 124	30	n/a	n/a
1,3-Dichloropropene, trans-	0.216	1.00	80 - 126	80 - 126	30	n/a	n/a
1,4-Dichloro-2-butene, trans-	0.437	5.00	62 - 127	62 - 127	30	n/a	7.4
2-Butanone (MEK)	0.513	5.00	64 - 120	64 - 120	30	n/a	2.70E+06
2-Hexanone (Methyl butyl ketone)	0.439	5.00	62 - 128	62 - 128	30	n/a	2.00E+04
4-Chlorotoluene	0.277	1.00	75 - 121	75 - 121	30	n/a	1.60E+05
4-Isopropyltoluene (4-Cymene)	0.236	1.00	78 - 131	78 - 131	30	n/a	n/a
Acetone	0.482	5.00	48 - 132	48 - 132	30	n/a	6.10E+06
Acrolein	3.81	50.0	60 - 130	60 - 130	30	n/a	14
Acrylonitrile	1.03	5.00	59 - 124	59 - 124	30	n/a	250
Benzene	0.296	1.00	80 - 120	80 - 120	30	n/a	1200
Bromobenzene	0.153	1.00	75 - 120	75 - 120	30	n/a	2.90E+04
Bromochloromethane	0.323	1.00	69 - 133	69 - 133	30	n/a	1.50E+04
Bromodichloromethane	0.254	1.00	80 - 122	80 - 122	30	n/a	290
Bromoform (Tribromomethane)	0.297	1.00	63 - 120	63 - 120	30	n/a	19000
Bromomethane (Methyl bromide)	0.187	1.00	40 - 172	40 - 172	30	n/a	680
Carbon disulfide	0.559	1.00	72 - 146	72 - 146	30	n/a	7.70E+04
Carbon tetrachloride (Tetrachloromethane)	0.213	1.00	76 - 136	76 - 136	30	n/a	650
Chlorobenzene	0.219	1.00	80 - 120	80 - 120	30	n/a	2.80E+04
Chloroethane	0.462	1.00	53 - 154	53 - 154	30	n/a	1.40E+06
Chloroform	0.234	1.00	75 - 126	75 - 126	30	n/a	320
Chloromethane	0.263	1.00	65 - 129	65 - 129	30	n/a	1.10E+04
Dibromochloromethane	0.266	1.00	77 - 123	77 - 123	30	n/a	8300
Dibromomethane	0.147	1.00	80 - 120	80 - 120	30	n/a	2400
Dichlorodifluoromethane	0.207	1.00	67 - 142	67 - 142	30	n/a	8700
Dichloromethane (Methylene chloride)	0.635	2.00	61 - 128	61 - 128	30	n/a	35000
Ethylbenzene	0.202	1.00	80 - 120	80 - 120	30	n/a	5800
Ethylene dibromide (1,2-Dibromoethane)	0.176	1.00	79 - 120	79 - 120	30	n/a	36
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	0.410	5.00	72 - 135	72 - 135	30	n/a	1200
Isopropylbenzene (Cumene)	0.233	1.00	77 - 127	77 - 127	30	n/a	1.90E+05
Methyl iodide (Iodomethane)	0.215	1.00	34 - 181	34 - 181	30	n/a	n/a
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	0.420	5.00	70 - 124	70 - 124	30	n/a	3.30E+06
Methyl tert-butyl ether (MTBE)	0.231	1.00	68 - 124	68 - 124	30	n/a	47000
n-Butylbenzene	0.262	1.00	75 - 134	75 - 134	30	n/a	3.90E+05
n-Propylbenzene	0.272	1.00	76 - 126	76 - 126	30	n/a	3.80E+05
o-Xylene	0.224	1.00	80 - 120	80 - 120	30	n/a	6.50E+04
sec-Butylbenzene	0.240	1.00	77 - 127	77 - 127	30	n/a	7.80E+05
Styrene	0.138	1.00	80 - 122	80 - 122	30	n/a	6.00E+05
tert-Butylbenzene	0.306	1.00	77 - 125	77 - 125	30	n/a	7.80E+05
Tetrachloroethene (PCE)	0.257	1.00	76 - 131	76 - 131	30	n/a	8100
Toluene	0.151	1.00	78 - 120	78 - 120	30	n/a	4.90E+05
Trichloroethene (TCE)	0.212	1.00	80 - 120	80 - 120	30	n/a	410
Trichlorofluoromethane (Fluorotrichloromethane)	0.266	1.00	57 - 161	57 - 161	30	n/a	2.30E+06
Vinyl acetate	0.381	5.00	54 - 138	54 - 138	30	n/a	9.10E+04
Vinyl chloride	0.235	1.00	74 - 134	74 - 134	30	n/a	59

Table A-2. Measurement Quality Objectives for Soil Samples

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte Name	MDL ⁽¹⁾	MRL	LCS/LCS %R ^(A)	MS/MSD %R ^(A)	RPD (%)	Surrogate %R ^(A)	Initial PRGs
1,2-Dichloroethane-d4	n/a	n/a	n/a	n/a	n/a	80 - 149	n/a
1,2-Dichlorobenzene-d4	n/a	n/a	n/a	n/a	n/a	80 - 120	n/a
Toluene-d8	n/a	n/a	n/a	n/a	n/a	77 - 120	n/a
4-Bromofluorobenzene	n/a	n/a	n/a	n/a	n/a	80 - 120	n/a
Dibromofluoromethane	n/a	n/a	n/a	n/a	n/a	80 - 120	n/a
Semivolatile Organic Compounds (SVOCs) by SW8270D (ug/kg)							
1,2,4-Trichlorobenzene	15.9	67.0	50 - 120	50 - 120	30	n/a	5800
1,2-Dichlorobenzene	18.4	67.0	48 - 120	48 - 120	30	n/a	1.80E+05
1,3-Dichlorobenzene	15.7	67.0	47 - 120	47 - 120	30	n/a	n/a
1,4-Dichlorobenzene	15.6	67.0	46 - 120	46 - 120	30	n/a	2600
1,4-Dioxane	n/a	67.0	n/a	n/a	30	n/a	5300
2,2'-Oxybis (1-chloropropane)	18.7	67.0	36 - 120	36 - 120	30	n/a	310000
2,4,5-Trichlorophenol	150	330	52 - 120	52 - 120	30	n/a	6.30E+05
2,4,6-Trichlorophenol	142	330	51 - 120	51 - 120	30	n/a	6300
2,4-Dichlorophenol	74.7	330	51 - 120	51 - 120	30	n/a	1.90E+04
2,4-Dimethylphenol	16.2	67.0	40 - 120	40 - 120	30	n/a	1.30E+05
2,4-Dinitrophenol	77.3	670	15 - 169	15 - 169	30	n/a	1.30E+04
2,4-Dinitrotoluene	96.0	330	57 - 127	57 - 127	30	n/a	1700
2,6-Dinitrotoluene	96.0	330	54 - 124	54 - 124	30	n/a	360
2-Chloronaphthalene	21.3	67.0	48 - 120	48 - 120	30	n/a	4.80E+05
2-Chlorophenol	14.3	67.0	45 - 120	45 - 120	30	n/a	3.90E+04
2-Methylphenol (o-Cresol)	23.3	67.0	45 - 120	45 - 120	30	n/a	3.20E+05
2-Nitroaniline	120	330	51 - 120	51 - 120	30	n/a	6.30E+04
2-Nitrophenol	63.4	67.0	50 - 120	50 - 120	30	n/a	n/a
3,3'-Dichlorobenzidine	89.3	330	37 - 140	37 - 140	30	n/a	1200
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	n/a	n/a	n/a	n/a	n/a	n/a	6.30E+05
3-Methylphenol (m-Cresol)	n/a	n/a	n/a	n/a	n/a	n/a	3.20E+05
3-Nitroaniline	104	330	39 - 142	39 - 142	30	n/a	n/a
4-Bromophenyl-phenyl ether	19.3	67.0	50 - 120	50 - 120	30	n/a	n/a
4-Chloro-3-methylphenol	115	330	54 - 120	54 - 120	30	n/a	6.30E+05
4-Chloroaniline	100	330	17 - 149	17 - 149	30	n/a	2700
4-Methylphenol (p-Cresol)	22.4	67.0	47 - 120	47 - 120	30	n/a	6.30E+05
4-Nitroaniline	102	330	47 - 124	47 - 124	30	n/a	25000
4-Nitrophenol	48.2	330	23 - 130	23 - 130	30	n/a	n/a
Aniline	21.8	67.0	10 - 129	10 - 129	30	n/a	44000
Benzidine	210	670	57 - 120	57 - 120	30	n/a	0.53
Benzoic acid	251	670	10 - 160	10 - 160	30	n/a	2.50E+07
Benzyl alcohol	86.7	330	16 - 120	16 - 120	30	n/a	6.30E+05
Biphenyl (1,1'-Biphenyl)	1.44	5.00	30 - 160	30 - 160	30	n/a	4700
bis(2-Chloroethoxy)methane	17.3	67.0	49 - 120	49 - 120	30	n/a	1.90E+04
bis(2-Chloroethyl)ether	16.9	67.0	43 - 120	43 - 120	30	n/a	230
bis(2-Ethylhexyl)phthalate	23.9	67.0	63 - 128	63 - 128	30	n/a	39000
Butylbenzyl phthalate	24.6	67.0	44 - 144	44 - 144	30	n/a	2.90E+05
Dibenzofuran	18.2	67.0	55 - 120	55 - 120	30	n/a	7300
Diethyl phthalate	20.9	67.0	54 - 120	54 - 120	30	n/a	5.10E+06
Dimethyl phthalate	26.5	67.0	56 - 120	56 - 120	30	n/a	n/a
Di-n-butyl phthalate	33.1	67.0	60 - 120	60 - 120	30	n/a	6.30E+05
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	122	670	10 - 157	10 - 157	30	n/a	510
Di-n-octyl phthalate	19.1	67.0	59 - 120	59 - 120	30	n/a	6.30E+04
Hexachlorobenzene	18.9	67.0	50 - 121	50 - 121	30	n/a	210
Hexachlorocyclopentadiene	62.4	330	23 - 149	23 - 149	30	n/a	1.80E+02
Hexachloroethane	18.8	67.0	43 - 120	43 - 120	30	n/a	1800
Isophorone	13.4	67.0	57 - 120	57 - 120	30	n/a	5.70E+05
Nitrobenzene	25.6	67.0	39 - 120	39 - 120	30	n/a	5100
n-Nitrosodimethylamine	84.0	330	43 - 120	43 - 120	30	n/a	2
n-Nitrosodi-n-propylamine	20.8	67.0	44 - 120	44 - 120	30	n/a	78
n-Nitrosodiphenylamine	16.9	67.0	54 - 138	54 - 138	30	n/a	110000
Pentachlorophenol	96.7	330	40 - 123	40 - 123	30	n/a	1000
Phenol	16.1	67.0	37 - 120	37 - 120	30	n/a	1.90E+06
2-Fluorophenol	n/a	n/a	n/a	n/a	n/a	22 - 120	n/a
Phenol-d5	n/a	n/a	n/a	n/a	n/a	27 - 120	n/a
2-Chlorophenol-d4	n/a	n/a	n/a	n/a	n/a	36 - 120	n/a
1,2-Dichlorobenzene-d4	n/a	n/a	n/a	n/a	n/a	38 - 120	n/a
Nitrobenzene-d5	n/a	n/a	n/a	n/a	n/a	32 - 120	n/a
2-Fluorobiphenyl	n/a	n/a	n/a	n/a	n/a	39 - 120	n/a
2,4,6-Tribromophenol	n/a	n/a	n/a	n/a	n/a	31 - 131	n/a
p-Terphenyl-d14	n/a	n/a	n/a	n/a	n/a	31 - 130	n/a
Polycyclic Aromatic Hydrocarbons by SW8270D-SIM (ug/kg)							
1-Methylnaphthalene	1.61	5.00	39 - 120	39 - 120	30	n/a	18000
2-Methylnaphthalene	1.69	5.00	35 - 120	35 - 120	30	n/a	2.40E+04
Acenaphthene	1.49	5.00	39 - 120	39 - 120	30	n/a	3.60E+05
Acenaphthylene	1.61	5.00	35 - 120	35 - 120	30	n/a	n/a
Anthracene	1.78	5.00	36 - 120	36 - 120	30	n/a	1.80E+06
Benzo(a)anthracene	2.22	5.00	42 - 120	42 - 120	30	n/a	160
Benzo(a)pyrene	2.38	5.00	36 - 120	36 - 120	30	n/a	16
Benzo(b)fluoranthene	2.11	5.00	35 - 127	35 - 127	30	n/a	160
Benzo(g,h,i)perylene	2.79	5.00	38 - 120	38 - 120	30	n/a	n/a
Benzo(k)fluoranthene	2.28	5.00	37 - 129	37 - 129	30	n/a	1600
Chrysene	1.92	5.00	48 - 120	48 - 120	30	n/a	16000
Dibenzo(a,h)anthracene	2.56	5.00	38 - 120	38 - 120	30	n/a	16
Fluoranthene	1.87	5.00	46 - 120	46 - 120	30	n/a	2.40E+05
Fluorene	1.47	5.00	41 - 120	41 - 120	30	n/a	2.40E+05
Indeno(1,2,3-c,d)pyrene	3.01	5.00	40 - 120	40 - 120	30	n/a	160
Naphthalene	2.26	5.00	36 - 120	36 - 120	30	n/a	3800
Phenanthrene	1.58	5.00	46 - 120	46 - 120	30	n/a	n/a

Table A-2. Measurement Quality Objectives for Soil Samples

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte Name	MDL ⁽¹⁾	MRL	LCS/LCS %R ^(A)	MS/MSD %R ^(A)	RPD (%)	Surrogate %R ^(A)	Initial PRGs
Pyrene	2.26	5.00	49 - 120	49 - 120	30	n/a	1.80E+05
Total HPAH	n/a	n/a	n/a	n/a	n/a	n/a	1100
Total LPAH	n/a	n/a	n/a	n/a	n/a	n/a	29000
Total PAH	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2-Methylnaphthalene-d10	n/a	n/a	n/a	n/a	n/a	32 - 120	n/a
Dibenzo[a,h]anthracene-d14	n/a	n/a	n/a	n/a	n/a	21 - 133	n/a
Fluoranthene-d10	n/a	n/a	n/a	n/a	n/a	36 - 134	n/a
Petroleum Hydrocarbons by NWTPH-HCID (mg/kg)							
Gasoline Range Hydrocarbons	n/a	20	n/a	n/a	n/a	n/a	n/a
Diesel Range Hydrocarbons	1.50	50	n/a	n/a	n/a	n/a	n/a
Oil Range Hydrocarbons	3.00	100	n/a	n/a	n/a	n/a	n/a
o-Terphenyl	n/a	n/a	n/a	n/a	n/a	50-150	n/a
n-Triacontane	n/a	n/a	n/a	n/a	n/a	50-150	n/a
Dioxins and Furans by SW8290C (ng/kg)							
2,3,7,8-TCDD	EDL	0.5	50-150	50-150	20	n/a	
1,2,3,7,8-PeCDD	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,4,7,8-HxCDD	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,6,7,8-HxCDD	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,7,8,9-HxCDD	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,4,6,7,8-HpCDD	EDL	2.5	50-150	50-150	20	n/a	
OCDD	EDL	5	50-150	50-150	20	n/a	
2,3,7,8-TCDF	EDL	0.5	50-150	50-150	20	n/a	
1,2,3,7,8-PeCDF	EDL	2.5	50-150	50-150	20	n/a	
2,3,4,7,8-PeCDF	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,4,7,8-HxCDF	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,6,7,8-HxCDF	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,7,8,9-HxCDF	EDL	2.5	50-150	50-150	20	n/a	
2,3,4,6,7,8-HxCDF	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,4,6,7,8-HpCDF	EDL	2.5	50-150	50-150	20	n/a	
1,2,3,4,7,8,9-HpCDF	EDL	2.5	50-150	50-150	20	n/a	
OCDF	EDL	5	n/a	n/a	20	n/a	
TCDD, Total	EDL	0.5	n/a	n/a	20	n/a	
PeCDD, Total	EDL	2.5	n/a	n/a	20	n/a	
HxCDD, Total	EDL	2.5	n/a	n/a	20	n/a	
HpCDD, Total	EDL	2.5	n/a	n/a	20	n/a	
TCDF, Total	EDL	0.5	n/a	n/a	20	n/a	
PeCDF, Total	EDL	2.5	n/a	n/a	20	n/a	
HxCDF, Total	EDL	2.5	n/a	n/a	20	n/a	
HpCDF, Total	EDL	2.5	n/a	n/a	20	n/a	
2,3,7,8-TCDD-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,7,8-PeCDD-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,6,7,8-HeCDD-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,4,6,7,8-HpCDD-C13	n/a	n/a	n/a	n/a	n/a	40-135	
OCDD-C13	n/a	n/a	n/a	n/a	n/a	40-135	
2,3,7,8-TCDF-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,7,8-PeCDF-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,4,7,8-HeCDF-C13	n/a	n/a	n/a	n/a	n/a	40-135	
1,2,3,4,6,7,8-HpCDF-C13	n/a	n/a	n/a	n/a	n/a	40-135	
2,3,7,8-TCDD-Cl37	n/a	n/a	n/a	n/a	n/a	40-135	
Organichlorine Pesticides by EPA 8081B (ug/kg)							
alpha-BHC	0.17	1.7	39-120	39-120	30	n/a	86
beta-BHC	0.318	1.7	43-120	43-120	30	n/a	300
gamma-BHC (Lindane)	0.175	1.7	46-120	46-120	30	n/a	570
delta-BHC	0.3	1.7	31-132	31-132	30	n/a	n/a
Heptachlor	0.218	1.7	40-120	40-120	30	n/a	130
Aldrin	0.218	1.7	40-120	40-120	30	n/a	39
Heptachlor Epoxide	0.286	1.7	46-126	46-126	30	n/a	70
trans-Chlordane	0.264	1.7	44-125	44-125	30	n/a	n/a
cis-Chlordane	0.282	1.7	43-127	43-127	30	n/a	n/a
Endosulfan I	0.273	1.7	41-130	41-130	30	n/a	n/a
4,4'-DDE	0.568	3.3	60-134	60-134	30	n/a	2000
Dieldrin	0.563	3.3	44-129	44-129	30	n/a	4.9
Endrin	0.518	3.3	56-120	56-120	30	n/a	1900
Endosulfan II	0.561	3.3	56-120	56-120	30	n/a	n/a
4,4'-DDD	0.575	3.3	60-120	60-120	30	n/a	2300
Endrin Aldehyde	0.963	3.3	32-120	32-120	30	n/a	n/a
4,4'-DDT	0.572	3.3	63-120	63-120	30	n/a	1900
Endosulfan Sulfate	0.844	3.3	47-120	47-120	30	n/a	n/a
Methoxychlor	3.52	17	58-120	58-120	30	n/a	32000
Polychlorinated Biphenyls by EPA 8082 (ug/kg)							
Aroclor 1016	10.7	330	51-120	51-120	30	n/a	410
Aroclor 1221	10.7	330	51-120	51-120	31	n/a	200
Aroclor 1232	10.7	330	51-120	51-120	32	n/a	170
Aroclor 1242	10.7	330	51-120	51-120	33	n/a	230
Aroclor 1248	10.7	330	51-120	51-120	34	n/a	230
Aroclor 1254	10.7	330	51-120	51-120	35	n/a	120
Aroclor 1260	14.4	330	59-120	59-120	30	n/a	240

Notes:

⁽¹⁾ - Based on current laboratory control criteria. Some values may vary slightly between instruments and can be subject to change as the laboratory updates the charted values periodically.

⁽²⁾ - For comparison of MRL to PRGs, the lowest initial PRG for surface or subsurface soil is stated here.

%R - Percent recovery

EDL - Estimated detection limit; value is calculated based on actual instrument response on a sample-specific basis.

LCS/LCSD - Laboratory control samples and laboratory control sample duplicate

MDL - Method detection limit

mg/kg - milligram per kilogram

MRL - Method reporting limit

MS/MSD - Matrix spike and matrix spike duplicate

n/a - not applicable

ng/kg - nanogram per kilogram

RPD - Relative percent difference

Table A-3. Measurement Quality Objectives for Groundwater Samples

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte Name	MDL ⁽¹⁾	MRL	LCS/LCS %R ^(A)	MS/MSD %R ^(A)	RPD (%)	Surrogate %R ^(A)	Initial PRGs
Conventional Chemical Parameters (mg/L)							
Ammonia as Nitrogen	0.0130	0.100	75 - 120	75 - 125	20	n/a	n/a
Cyanide	0.00300	0.00500	75 - 120	75 - 125	20	n/a	0.15
Sulfide	0.0300	0.0500	75 - 120	75 - 125	20	n/a	n/a
Total and Dissolved Metals by EPA 200.8 (µg/L)							
Antimony	0.01	0.2	80 - 120	75 - 125	20	n/a	0.78
Arsenic	0.048	0.2	80 - 120	75 - 125	20	n/a	0.052
Beryllium	0.021	0.2	80 - 120	75 - 125	20	n/a	2.5
Cadmium	0.01	0.1	80 - 120	75 - 125	20	n/a	0.92
Chromium	0.045	0.5	80 - 120	75 - 125	20	n/a	100
Chromium VI (SM3500-Cr-B)	0.003	0.01	75-125	75-125	20	n/a	0.035
Copper	0.158	0.5	80 - 120	75 - 125	20	n/a	80
Lead	0.046	0.1	80 - 120	75 - 125	20	n/a	15
Nickel	0.079	0.5	80 - 120	75 - 125	20	n/a	39
Selenium	0.127	0.5	80 - 120	75 - 125	20	n/a	10
Silver	0.008	0.2	80 - 120	75 - 125	20	n/a	9.4
Thallium	0.004	0.2	80 - 120	75 - 125	20	n/a	8.6
Zinc	0.497	4.0	80 - 120	75 - 125	20	n/a	600
Total and Dissolved Mercury by EPA 7470A (µg/L)							
Mercury	0.007000	0.100	80 - 120	75 - 125	20	n/a	0.063
Volatile Organic Compounds (VOCs) by SW8260C (µg/L)							
1,1,1,2-Tetrachloroethane	0.0396	0.200	80 - 128	80 - 128	30	n/a	0.57
1,1,1-Trichloroethane	0.0408	0.200	79 - 124	79 - 124	30	n/a	200
1,1,2,2-Tetrachloroethane	0.0598	0.200	80 - 120	80 - 120	30	n/a	0.076
1,1,2-Trichloroethane	0.129	0.200	80 - 120	80 - 120	30	n/a	0.041
1,1,2-Trichlorotrifluoroethane (Freon 113)	0.0429	0.200	76 - 124	76 - 124	30	n/a	5,500
1,1-Dichloroethane	0.0533	0.200	80 - 120	80 - 120	30	n/a	2.8
1,1-Dichloroethene	0.0540	0.200	74 - 120	74 - 120	30	n/a	7
1,2,3-Trichlorobenzene	0.110	0.500	80 - 125	80 - 125	30	n/a	0.7
1,2,3-Trichloropropane	0.131	0.500	80 - 120	80 - 120	30	n/a	0.00075
1,2,4-Trimethylbenzene	0.0243	0.200	80 - 122	80 - 122	30	n/a	1.5
1,2-Dibromo-3-chloropropane	0.366	0.500	79 - 129	79 - 129	30	n/a	0.00033
1,2-Dichloroethane	0.0717	0.200	80 - 121	80 - 121	30	n/a	0.17
1,2-Dichloroethene, cis-	0.0427	0.200	78 - 120	78 - 120	30	n/a	3.6
1,2-Dichloroethene, trans-	0.0485	0.200	75 - 120	75 - 120	30	n/a	36
1,2-Dichloropropane	0.0352	0.200	80 - 120	80 - 120	30	n/a	0.44
1,3,5-Trimethylbenzene (Mesitylene)	0.0150	0.200		80 - 120	30	n/a	12
1,3-Dichloropropane	0.0622	0.200	80 - 120	80 - 120	30	n/a	37
1,3-Dichloropropene, cis-	0.0610	0.200	80 - 127	80 - 127	30	n/a	n/a
1,3-Dichloropropene, trans-	0.0815	0.200	79 - 132	79 - 132	30	n/a	n/a
1,4-Dichloro-2-butene, trans-	0.324	1.00	47 - 147	47 - 147	30	n/a	0.0013
2-Butanone (MEK)	0.814	5.00	73 - 123	73 - 123	30	n/a	560
2-Chlorotoluene	0.0236	0.200	80 - 120	80 - 120	30	n/a	24
2-Hexanone (Methyl butyl ketone)	0.902	5.00	80 - 129	80 - 129	30	n/a	3.8
4-Chlorotoluene	0.0159	0.200	80 - 120	80 - 120	30	n/a	25
4-Isopropyltoluene (4-Cymene)	0.0263	0.200	80 - 124	80 - 124	30	n/a	n/a
Acetone	2.06	5.00	64 - 125	64 - 125	30	n/a	1,400
Acrolein	2.48	5.00	60 - 124	60 - 124	30	n/a	0.0042
Acrylonitrile	0.604	1.00	76 - 123	76 - 123	30	n/a	0.052
Benzene	0.0266	0.200	80 - 120	80 - 120	30	n/a	0.46
Bromobenzene	0.0605	0.200	80 - 120	80 - 120	30	n/a	6.2
Bromochloromethane	0.0607	0.200	80 - 120	80 - 120	30	n/a	8.3
Bromodichloromethane	0.0506	0.200	80 - 122	80 - 122	30	n/a	0.13
Bromoform (Tribromomethane)	0.0618	0.200	62 - 149	62 - 149	30	n/a	3.3
Bromomethane (Methyl bromide)	0.252	1.00	68 - 130	68 - 130	30	n/a	0.75
Carbon disulfide	0.0370	0.200	77 - 124	77 - 124	30	n/a	81
Carbon tetrachloride (Tetrachloromethane)	0.0439	0.200	71 - 139	71 - 139	30	n/a	0.46
Chlorobenzene	0.0230	0.200	80 - 120	80 - 120	30	n/a	7.8
Chloroethane	0.0861	0.200	68 - 133	68 - 133	30	n/a	2,100
Chloroform	0.0273	0.200	80 - 120	80 - 120	30	n/a	0.22
Chloromethane	0.0948	0.500	77 - 122	77 - 122	30	n/a	19
Dibromochloromethane	0.0481	0.200	80 - 120	80 - 120	30	n/a	0.87
Dibromomethane	0.145	0.200	80 - 120	80 - 120	30	n/a	0.83
Dichlorodifluoromethane	0.0521	0.200	68 - 133	68 - 133	30	n/a	20
Dichloromethane (Methylene chloride)	0.485	1.00	71 - 125	71 - 125	30	n/a	5
Ethylbenzene	0.0371	0.200	80 - 120	80 - 120	30	n/a	1.5
Ethylene dibromide (1,2-Dibromoethane)	0.0745	0.200	80 - 120	80 - 120	30	n/a	0.0075
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	0.0734	0.500	80 - 135	80 - 135	30	n/a	0.14
Isopropylbenzene (Cumene)	0.0212	0.200	80 - 120	80 - 120	30	n/a	45
Methyl iodide (Iodomethane)	0.227	1.00	76 - 123	76 - 123	30	n/a	n/a
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	0.974	5.00	80 - 125	80 - 125	30	n/a	630
Methyl tert-butyl ether (MTBE)	0.0729	0.500	79 - 121	79 - 121	30	n/a	14
n-Butylbenzene	0.0248	0.200	80 - 125	80 - 125	30	n/a	100
n-Propylbenzene	0.0235	0.200	80 - 120	80 - 120	30	n/a	66
o-Xylene	0.0349	0.200	80 - 120	80 - 120	30	n/a	19
sec-Butylbenzene	0.0237	0.200	80 - 121	80 - 121	30	n/a	200
Styrene	0.0454	0.200	80 - 121	80 - 121	30	n/a	100
tert-Butylbenzene	0.0256	0.200	80 - 121	80 - 121	30	n/a	69
Tetrachloroethene (PCE)	0.0474	0.200	80 - 120	80 - 120	30	n/a	4.1
Toluene	0.0399	0.200	80 - 120	80 - 120	30	n/a	110
Trichloroethene (TCE)	0.0489	0.200	80 - 120	80 - 120	30	n/a	0.28
Trichlorofluoromethane (Fluorotrichloromethane)	0.0375	0.200	74 - 135	74 - 135	30	n/a	520
Vinyl acetate	0.0688	0.200	74 - 120	74 - 120	30	n/a	41
Vinyl chloride	0.0572	0.200	74 - 123	74 - 123	30	n/a	0.019
Semivolatile Organic Compounds (SVOCs) by SW8270D (µg/L)							
1,2,4-Trichlorobenzene	0.254	1.00	28 - 120	28 - 120	30	n/a	0.4
1,2-Dichlorobenzene	0.250	1.00	28 - 120	28 - 120	30	n/a	30
1,3-Dichlorobenzene	0.266	1.00	24 - 120	24 - 120	30	n/a	n/a
1,4-Dichlorobenzene	0267	1.00	24 - 120	24 - 120	30	n/a	0.48
1,4-Dioxane	0.0847	0.4	45-120	45-120	40	39-129	0.46

Table A-3. Measurement Quality Objectives for Groundwater Samples

Bremerton Gas Works Superfund Site
Bremerton, Washington

Analyte Name	MDL ⁽¹⁾	MRL	LCS/LCS %R ^(A)	MS/MSD %R ^(A)	RPD (%)	Surrogate %R ^(A)	Initial PRGs
2,2'-Oxybis (1-chloropropane)	0.241	1.00	47 - 120	47 - 120	30	n/a	71
2,3,4,6-Tetrachlorophenol	0.244	1.00	0	0	30	n/a	24
2,4,5-Trichlorophenol	1.10	5.00	58 - 120	58 - 120	30	n/a	120
2,4,6-Trichlorophenol	1.04	3.00	53 - 120	53 - 120	30	n/a	1.2
2,4-Dichlorophenol	1.11	3.00	54 - 120	54 - 120	30	n/a	4.6
2,4-Dimethylphenol	1.12	3.00	37 - 120	37 - 120	30	n/a	36
2,4-Dinitrophenol	3.35	20.0	40 - 120	40 - 120	30	n/a	3.9
2,4-Dinitrotoluene	1.12	3.00	51 - 120	51 - 120	30	n/a	0.24
2,6-Dinitrotoluene	1.14	3.00	52 - 120	52 - 120	30	n/a	0.049
2-Chloronaphthalene	0.248	1.00	42 - 120	42 - 120	30	n/a	75
2-Chlorophenol	0.220	1.00	48 - 120	48 - 120	30	n/a	9.1
2-Methylphenol (o-Cresol)	0.211	1.00	44 - 120	44 - 120	30	n/a	93
2-Nitroaniline	1.46	3.00	31 - 120	31 - 120	30	n/a	19
2-Nitrophenol	0.263	3.00	47 - 120	47 - 120	30	n/a	n/a
3,3'-Dichlorobenzidine	1.77	5.00	44 - 120	44 - 120	30	n/a	0.13
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	n/a	n/a	n/a	n/a	n/a	n/a	150
3-Methylphenol (m-Cresol)	n/a	n/a	n/a	n/a	n/a	n/a	93
3-Nitroaniline	1.53	3.00	36 - 120	36 - 120	30	n/a	n/a
4-Bromophenyl-phenyl ether	0.238	1.00	56 - 120	56 - 120	30	n/a	n/a
4-Chloro-3-methylphenol	1.12	3.00	59 - 120	59 - 120	30	n/a	140
4-Chloroaniline	1.73	5.00	10 - 132	10 - 132	30	n/a	0.37
4-Methylphenol (p-Cresol)	0.468	2.00	48 - 120	48 - 120	30	n/a	190
4-Nitroaniline	2.02	3.00	25 - 132	25 - 132	30	n/a	3.8
4-Nitrophenol	1.75	10.0	44 - 129	44 - 129	30	n/a	n/a
Aniline	0.973	1.00	21 - 120	21 - 120	30	n/a	13
Benzoic acid	3.92	3.92	37 - 120	37 - 120	30	n/a	7500
Benzyl alcohol	0.552	0.552	26 - 120	26 - 120	30	n/a	200
bis(2-Chloroethoxy)methane	0.237	1.00	48 - 120	48 - 120	30	n/a	5.9
bis(2-Chloroethyl)ether	0.248	1.00	50 - 120	50 - 120	30	n/a	0.014
bis(2-Ethylhexyl)phthalate	2.14	3.00	58 - 120	58 - 120	30	n/a	5.6
Butylbenzyl phthalate	0.299	1.00	54 - 120	54 - 120	30	n/a	16
Dibenzofuran	0.309	1.00	36 - 120	36 - 120	30	n/a	0.79
Diethyl phthalate	0.273	1.00	60 - 120	60 - 120	30	n/a	1500
Dimethyl phthalate	0.259	1.00	61 - 120	61 - 120	30	n/a	n/a
Di-n-butyl phthalate	0.291	1.00	65 - 120	65 - 120	30	n/a	90
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	3.61	10.0	56 - 120	56 - 120	30	n/a	0.15
Di-n-octyl phthalate	0.268	1.00	62 - 120	62 - 120	30	n/a	20
Hexachlorobenzene	0.280	1.00	54 - 120	54 - 120	30	n/a	0.0098
Hexachlorocyclopentadiene	1.08	5.00	16 - 120	16 - 120	30	n/a	0.041
Hexachloroethane	0.300	2.00	18 - 120	18 - 120	30	n/a	0.33
Isophorone	0.423	1.00	57 - 120	57 - 120	30	n/a	78
Nitrobenzene	0.253	1.00	49 - 120	49 - 120	30	n/a	0.14
n-Nitrosodimethylamine	1.33	3.00	41 - 120	41 - 120	30	n/a	0.00011
n-Nitrosodi-n-propylamine	0.269	1.00	50 - 120	50 - 120	30	n/a	0.011
n-Nitrosodiphenylamine	0.299	1.00	48 - 120	48 - 120	30	n/a	12
Pentachlorophenol	1.89	10.0	40 - 131	40 - 131	30	n/a	0.041
Phenol	0.271	1.00	48 - 120	48 - 120	30	n/a	580
Polycyclic Aromatic Hydrocarbons (PAHs) by SW8270D-SIM (µg/L)							
1-Methylnaphthalene	0.00313	0.0100	29 - 120	29 - 120	30	n/a	1.1
2-Methylnaphthalene	0.00384	0.0100	37 - 120	37 - 120	30	n/a	3.6
Acenaphthene	0.00311	0.0100	41 - 120	41 - 120	30	n/a	53
Acenaphthylene	0.00317	0.0100	41 - 120	41 - 120	30	n/a	n/a
Anthracene	0.00248	0.0100	40 - 120	40 - 120	30	n/a	180
Benzo(a)anthracene	0.00347	0.0100	42 - 120	42 - 120	30	n/a	0.012
Benzo(a)pyrene	0.00237	0.0100	35 - 120	35 - 120	30	n/a	0.0034
Benzo(b)fluoranthene	0.00356	0.0100	44 - 120	44 - 120	30	n/a	0.034
Benzo(g,h,i)perylene	0.00312	0.0100	38 - 120	38 - 120	30	n/a	n/a
Benzo(k)fluoranthene	0.00345	0.0100	50 - 120	50 - 120	30	n/a	0.34
Chrysene	0.00313	0.0100	44 - 120	44 - 120	30	n/a	3.4
Dibenzo(a,h)anthracene	0.00303	0.0100	34 - 120	34 - 120	30	n/a	0.0034
Fluoranthene	0.00337	0.0100	45 - 120	45 - 120	30	n/a	80
Fluorene	0.00317	0.0100	43 - 120	43 - 120	30	n/a	29
Indeno(1,2,3-c,d)pyrene	0.00334	0.0100	37 - 120	37 - 120	30	n/a	0.034
Naphthalene	0.00740	0.0100	37 - 120	37 - 120	30	n/a	0.17
Phenanthrene	0.00299	0.0100	41 - 120	41 - 120	30	n/a	n/a
Pyrene	0.00417	0.0100	41 - 120	41 - 120	30	n/a	87
Total Benzofluoranthenes (b,j,k)	0.00356	0.0100	46 - 120	46 - 120	30	n/a	n/a
Total HPAH	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total LPAH	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total PAH	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Petroleum Hydrocarbons by NWTPH-HCID (µg/L)							
Gasoline Range Hydrocarbons	n/a	250	n/a	n/a	n/a	n/a	n/a
Diesel Range Hydrocarbons	30	500	n/a	n/a	n/a	n/a	n/a
Oil Range Hydrocarbons	50	1000	n/a	n/a	n/a	n/a	n/a

Notes:

- ⁽¹⁾ - Based on current laboratory control criteria. Some values may vary slightly between instruments and can be subject to change as the laboratory updates the charted values periodically.
- %R - Percent recovery
- LCS/LCSD - Laboratory control samples and laboratory control sample duplicate
- MDL - Method detection limit
- mg/L - milligram per liter
- MRL - Method reporting limit
- MS/MSD - Matrix spike and matrix spike duplicate
- n/a - not applicable
- RPD - Relative percent difference
- tbd - to be determined

Table A-4. Sampling and Analysis Approach

Bremerton Gas Works Superfund Site
Bremerton, Washington

Upland RI Phase		Geophysical Survey	Source Characterization	Source Areas Investigation	Outside Source Areas Investigation
Soil Sample Chemical Analysis	VOCs (w/BTEX)		X	X	X
	SVOCs (w/PAHs)		X	X	X
	Cyanide		X	X	X
	Metals ¹		X	X	X
	PCBs		X	X	X
	Pesticides		X	X	X
	Dioxins/Furans		(a)	(a)	(c)
Soil Physical Properties ²				(b)	(b)
Groundwater Sample Chemical Analysis	VOCs (w/BTEX)			X	X
	SVOCs (w/PAHs)			X	X
	Cyanide			X	X
	Metals ¹			X	X
	PCBs			X	X
	Pesticides			X	X
	Dioxins/Furans				
Groundwater Field Parameters ³				X	X
Groundwater Conventional Parameters ⁴				X	X

Notes:

BTEX = benzene, toluene, ethylbenzene and xylenes

MNA = monitored natural attenuation

PAHs = polycyclic aromatic hydrocarbons

SVOCs = semivolatile organic compounds

PCBs = polychlorinated biphenyls

VOCs = volatile organic compounds

¹Metals include antimony, arsenic, cadmium, calcium, total chromium, hexavalent chromium, cobalt, copper, lead, magsensium, manganese, nickel, potassium, sodium, thallium, vanadium and zinc.

²Physical properties analysis consists of total organic carbon (TOC), grainsize, and Atterberg Limits

³Field parameters consist of oxidation-reduction potential (Eh), dissolved oxygen, conductivity, temperature and pH

⁴Conventional parameters include chloride, dissolved organic carbon, nitrate, nitrite, sulfate, sulfide, ferrous iron, dissolved manganese, and alkalinity.

X - Indicates that the samples collected during this phase of investigation will be submitted for analysis.

a) Samples of source material will be collected during this phase of investigation. Samples will be archived and a subset of samples will be submitted for laboratory analysis of dioxins/furans if PCBs, chlorinated phenols, or chlorinated pesticides are detected above reporting limits.

b) Soil samples of each lithologic unit and fill identified during this phase of investigation will be tested/analyzed for soil physical properties.

c) Soil samples collected during this phase of investigation will be sumitted for analysis of dioxinx/furans on a subset of samples if PCBs, chlorinated phenols, or chlorinated pesticides are detected above reporting limits.

Table A-5. Analytical Methods, Sample Containers, Preservation, and Holding Times

Bremerton Gas Works Superfund Site
Bremerton, Washington

Sample Matrix	Analytical Parameter	Analytical Method	Sample Container	No. Containers	Preservation Requirements	Holding Time
Soil	Petroleum Hydrocarbon Identification	NWTPH-HCID	8 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	VOCs	Method 8260C	Method 5035A, 40-ml vials, 2 ounce jar	5	4°C ±2°C, Freeze within 48 hours to <-7°C, Methanol, Sodium Bisulfate	14 days
	Low-level PAHs	Method 8270D-SIM	8 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	Metals	Method 200.8/7471A	4 ounce jar	1	4°C ±2°C	6 months, Hg-28 days
	SVOCs	Method 8270D	8 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	Pesticides	Method 8081B	8 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	PCBs	Method 8082	8 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	Dioxins/Furans	Method 1613	4 ounce jar	1	4°C ±2°C	1 year
	Cyanide	Method 9012	4 ounce jar	1	4°C ±2°C	14 days
	Grain Size	ASTM D422	8 ounce jar	4	none	n/a
	Atterberg Limits	ASTM D4318	8 ounce jar	2	none	n/a
	Total Organic Carbon	Plumb	4 ounce jar	1	4°C ±2°C	14 days
Groundwater	Petroleum Hydrocarbon Identification	NWTPH-HCID	500-mL Amber Glass, 40-ml VOA vial	2 ea	4°C ±2°C, HCl	7 days for extraction, 40 days for analysis
	VOCs	Method 8260C	40-mL VOA Vials	3	4°C ±2°C, 2 with HCl pH < 2, 2 without HCl	14 days for analysis
	Low-level PAHs	Method 8270D-SIM	500-mL Amber Glass	2	4°C ±2°C	7 days for extraction, 40 days for analysis
	SVOCs with low-level PAHs	Method 8270D	500-mL Amber Glass	2	4°C ±2°C	7 days for extraction, 40 days for analysis
	Metals, total/dissolved (field filter)	Method 200.7/200.8	500-mL HDPE	1	4°C ±2°C, HNO ₃ pH < 2 (after filtration)	180 days
	Dissolved Sulfide	Method 376.2	500-mL HDPE	1	4°C ±2°C, Zinc Acetate and NaOH pH > 9 (after filtration)	7 days
	Chloride	SM4500-Cl	250-mL HDPE	1	none	28 days
	Cyanide, Total	SM4500-CN	500-mL HDPE	1	NaOH, pH>12	14 days
	Dissolved Organic Carbon	SM5310B	250-mL Amber glass	1	H ₂ SO ₄ pH<2, ≤6°C, (after filtration)	28 days
	Nitrogen as Nitrate	353.2/9056	500-mL HDPE	1	≤6°C	48 hours
	Nitrogen as Nitrite	353.2/9056	500-mL HDPE	1	≤6°C	48 hours
	Sulfate	300.0/9056	500-mL HDPE	1	≤6°C	28 days
	Manganese, dissolved	Method 200.7/200.8	500-mL HDPE	1	4°C ±2°C, HNO ₃ pH < 2 (after filtration)	180 days
	Alkalinity	SM 2320B-97	500-mL HDPE	1	≤6°C	14 days
NAPL	Viscosity/Density	ASTM D445, D1481	250-mL Amber Glass	1	none	none
	Flash Point	ASTM D93	250-mL Amber Glass	1	none	none

Table A-5

Aspect Consulting

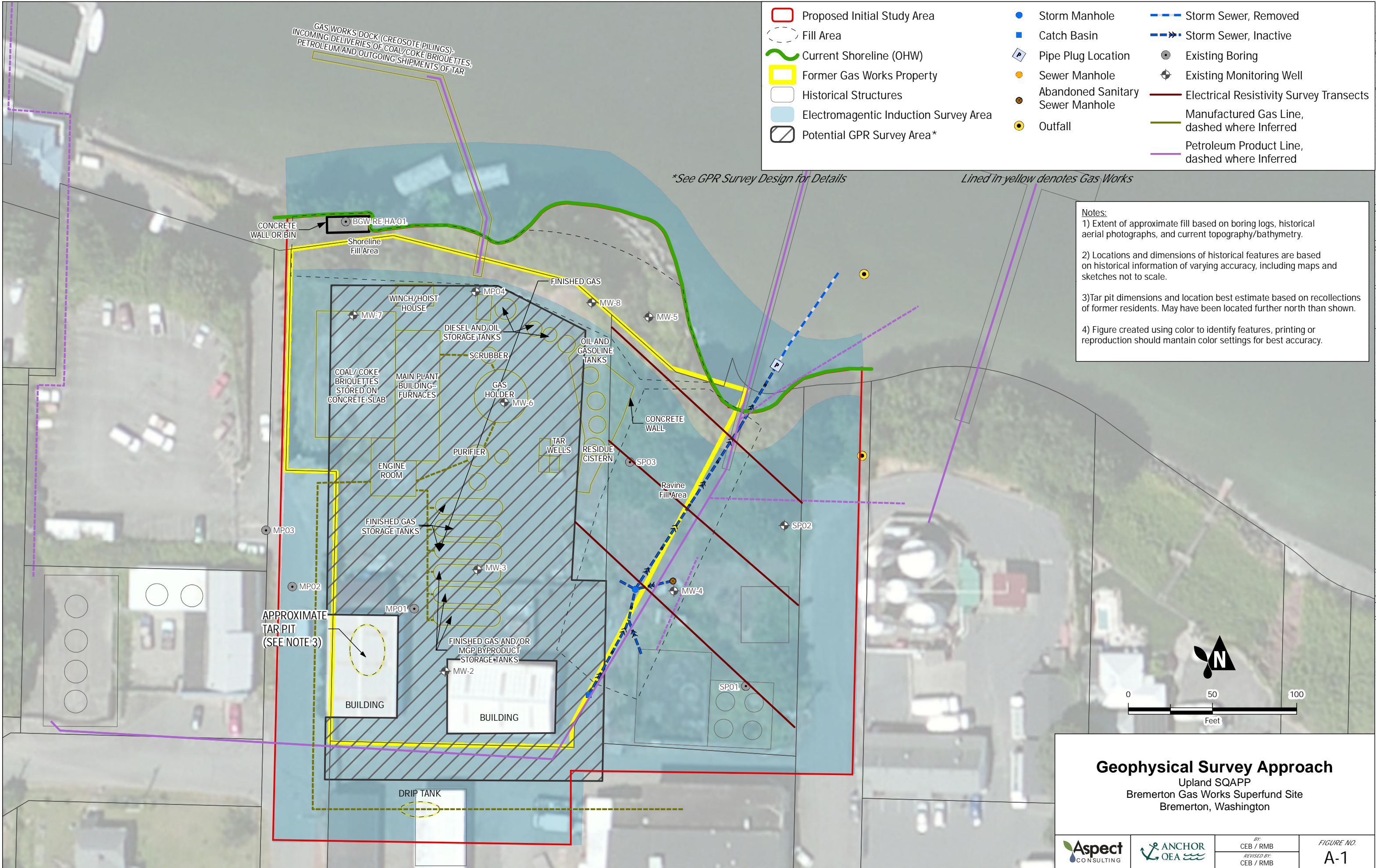
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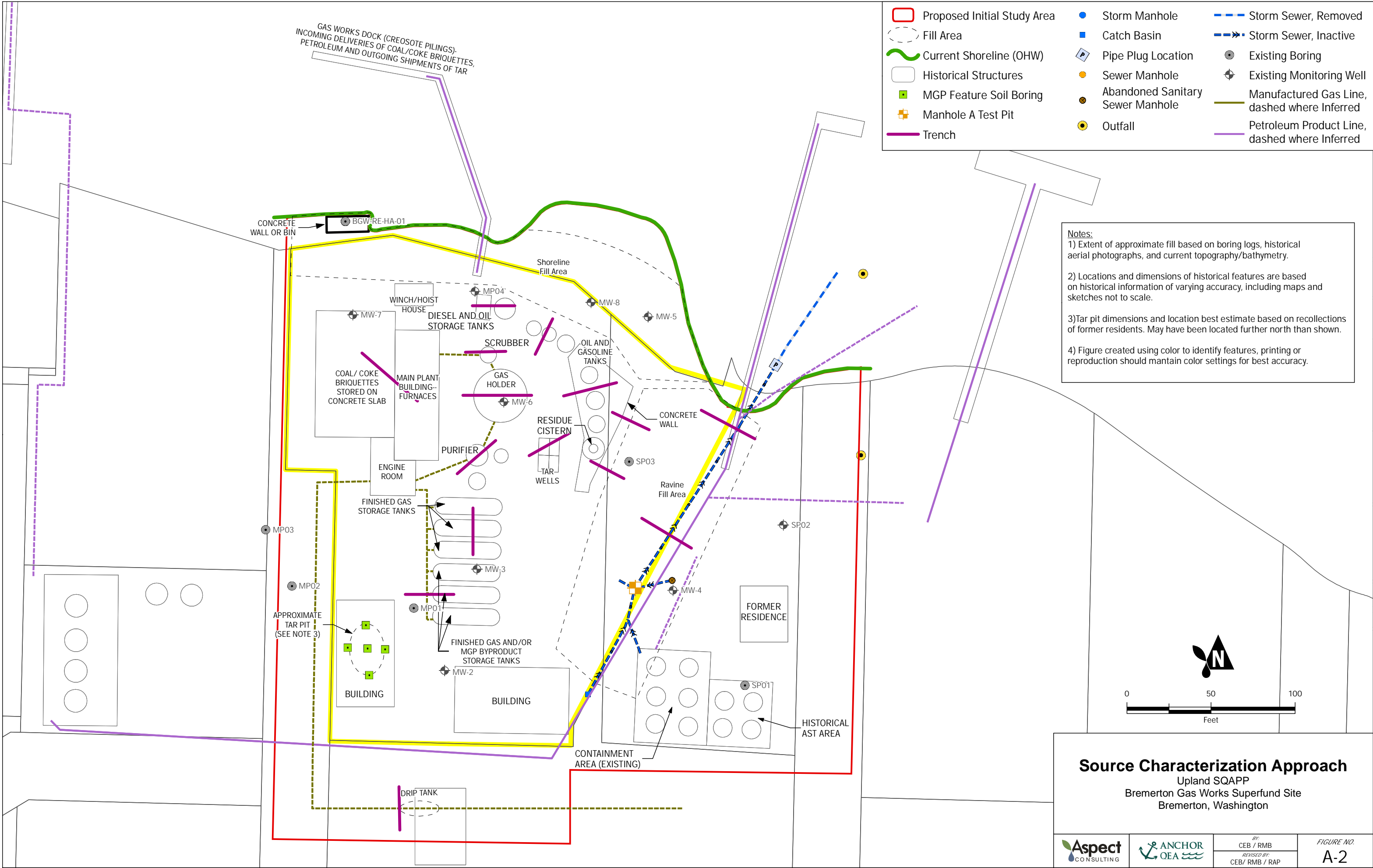
Final RI/FS Work Plan - Upland SQAPP

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FIGURES

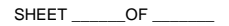




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ATTACHMENT A

Field Forms





GROUNDWATER SAMPLING RECORD						WELL NUMBER: _____		Page: ____ of ____			
Project Name: _____						Project Number:_____					
Date: _____						<div>Starting Water Level (ft TOC):_____</div> <div>Casing Stickup (ft):_____</div> <div>Total Depth (ft TOC):_____</div> <div>Casing Diameter (inches):_____</div>					
Developed by: _____											
Measuring Point of Well: _____											
Screened Interval (ft. TOC) _____											
Filter Pack Interval (ft. TOC) _____											
Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)											
Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf						Sample Intake Depth (ft TOC): _____					
2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf											
PURGING MEASUREMENTS											
Criteria:		Typical 0.1-0.5 Lpm	Stable and minimal and	na	± 3%	± 10%	± 0.1	± 10 mV	± 10%		
Time	Cumul. Volume (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments	
Total Gallons Purged: _____						Total Casing Volumes Removed: _____					
Ending Water Level (ft TOC): _____						Ending Total Depth (ft TOC):_____					
SAMPLE INVENTORY											
Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks		
							Color	Turbidity & Sediment			
METHODS											
Sampling Equipment with IDs: _____											
Purging Equipment: _____ Decon Equipment: _____											
Disposal of Discharged Water: _____											
Observations/Comments: _____											

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TEST PIT LOG



TEST PIT ID _____

DATE _____

LOCATION OF TEST PIT				PROJECT NAME	
SKETCH OF LOCATION				PROJECT NO.	
				LOGGED BY	
				CONTRACTOR	
				TOTAL DEPTH	
				DEPTH TO WATER	
DEPTH IN FEET	SAMPLE DEPTH	SAMPLE ID	USCS SUMMARY	SOIL DESCRIPTION	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					



350 Madison Avenue North
Bainbridge Island, Washington 98110
(206) 780-9370

401 Second Avenue S, Suite 201
Seattle, Washington 98104
(206) 328-7443

WELL DEVELOPMENT RECORD					WELL NUMBER: _____				Page: ____ of ____	
Project Name: _____					Project Number: _____		Date: _____			
Observer: _____					Developed by: _____					
Screened Interval (ft. BGS) _____					Measuring Point on Well: _____					
Filter Pack Interval (ft. BGS) _____					Casing Stickup (ft): _____					
Casing Size (in): _____ Mtl & Scd _____ ID (in) _____					Starting Water Level (ft TOC): _____					
Screen Size (in): _____ Mtl & Scd _____ ID (in) _____					Starting Total Depth (ft TOC): _____					
Screen Type: _____					Casing Volume _____ (ft water) x _____ (gpf) = _____ (gal)					
					Casing Volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf					
DEVELOPMENT MEASUREMENTS										
Time	Cumul. Vol. (gallons)	Purge Rate (gpm)	Temp.	Specific Conductance (umhos/cm)	pH	Turbidity	Imhoff Cone (ml/L)	Development Techniques		
Total Gallons Removed: _____					Ending Water Level (ft TOC): _____					
Total Casing Volumes Removed: _____					Ending Total Depth (ft TOC): _____					
METHODS										
Cleaning Equipment: _____										
Development Equipment: _____										
Disposal of Discharged Water: _____										
Observations/Comments: _____										

As-Built Well Completion Diagram

Project Number:	Boring/Monitoring Well Number:	Sheet:	of:
Project:	Location:		
Elevation:	Drilling Contractor:		
Drilling Method and Equipment Used:	Logged By:		
Water Levels:	Completion Start:	Finish:	

Ecology Well ID _____




Soil Type/ Depth	Completion Depths		
		Monument Type/Height _____	
		Well Cap Type _____	
		Surface Seal Material _____	
		Seal Material _____ (list NSF/ANSI certification)	
		Well Casing ID _____	
		Type of Casing _____	
		Type of Connection _____	
		Filter Pack/Size _____	
		Filter Pack Interval _____	
		Well Screen ID _____	
		Type of Screen _____	
		Slot Size _____	
		Screen Interval _____	
		Centralizers _____	
		Diameter of Borehole _____	
		Sump _____	
		Bottom of Boring _____	

Materials Used:	Screen:
Sand:	Bentonite:
Blank:	Monument:
Concrete:	Other:

ATTACHMENT B

Laboratory ISM SOP

Title: Incremental Sampling Methodology of Soils and Sediments

Approvals (Signature/Date):	
 Koroush Vaziri Department Manager	<u>7/14/2016</u> Date
 Joe Schairer Health & Safety Manager / Coordinator	<u>7/7/16</u> Date
 Lisa Stafford Quality Assurance Manager	<u>7/7/16</u> Date
 Crystal Pollock Laboratory Director	<u>7.11.16</u> Date

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Marine Sampling and Quality Assurance Project Plan

Appendix B of the Draft RI/FS Work Plan

Bremerton Gas Works Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01
May 31, 2017

Prepared by



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Seattle, Washington 98101

Marine Sampling and Quality Assurance Project Plan

Appendix B of the Draft RI/FS Work Plan

Bremerton Gas Works Site
Prepared for: Cascade Natural Gas Corporation

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Aspect Consulting, LLC & Anchor QEA, LLC

Title and Approval Page
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Marine Sampling and Quality Assurance Project Plan

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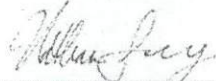
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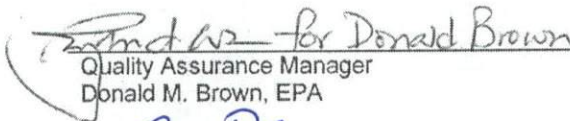
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Acronyms

°C	degrees Celsius
ADCP	acoustic doppler current profiler
Anchor QEA	Anchor QEA, LLC
AOC	Administrative Order on Consent
Aspect	Aspect Consulting, LLC
ASTM	American Society of Testing Materials
Cascade	Cascade Natural Gas Corporation
CCV	continuing calibration verification
COC	chain of custody
COPC	contaminant of potential concern
D/F	polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofuran
DGPS	digital global positioning system
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FC	Field Coordinator
FS	Feasibility Study
GC	gas chromatography
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
ISA	initial study area
MD	matrix duplicate
MDL	method detection limit
MGP	manufactured gas plant
MLLW	mean lower low water
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NAPL	nonaqueous phase liquid
NIST	National Institute of Standards and Technology

OSHA	Occupational Safety and Health Act
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PWN	Port Washington Narrows
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
Site	Bremerton Gas Works Site
SOP	Standard Operating Procedure
SPME	solid-phase microextraction
SQAPP	Sampling and Quality Assurance Project Plan
SVOC	semivolatile organic compound
TOC	total organic carbon
TS	total solids
VOC	volatile organic compound
WAD	weak acid dissociable
WDFW	Washington Department of Fish and Wildlife

1 Introduction

Cascade Natural Gas Corporation (Cascade) is conducting a Remedial Investigation (RI) and Feasibility Study (FS) at the Bremerton Gas Works Site (Site) in Bremerton, Washington under the direction of the U.S. Environmental Protection Agency (EPA). The work is being conducted in accordance with the Administrative Settlement Agreement and Order on Consent for Remedial Investigation Feasibility Study (AOC; Comprehensive Environmental Response, Compensation, and Liability Act Docket No 10-2013-0104). Consistent with the AOC, the Site includes the area where the Gas Works was formerly located (Figure B-1), and areas that may have been affected by contamination originating from the former Gas Works. This document describes the sampling and quality assurance project plan (SQAPP) for the marine environment and is Appendix B to the EPA-approved RI/FS Work Plan. Appendix A of the RI/FS Work Plan is the Upland SQAPP.

This SQAPP describes data quality objectives, sampling and analytical methods, quality assurance/quality control (QA/QC) procedures, and management of data to support the RI/FS. The SQAPPs provide supplemental information to the RI/FS Work Plan, and the documents should be used concurrently to achieve project goals.

1.1 Project Overview

This section presents a general overview of the marine Site characteristics used to inform the development of this SQAPP. More detailed information regarding environmental setting, resource, historical investigation data, and Time Critical Removal Actions is provided in the EPA-approved Scoping Memorandum and RI/FS Work Plan. The upland project overview is provided under a separate cover.

The Site encompasses upland and marine areas near the operation of a former manufactured gas plant (MGP) and adjacent areas where legacy contaminants have been located. The Site is adjacent to the Port Washington Narrows (PWN), which is a tidal channel connecting Dyes Inlet to Sinclair Inlet and the Puget Sound. The waters of PWN are relatively shallow, with average depths of less than 30 feet. Dyes Inlet is a terminal estuary, composed of five embayments (Phinney, Mud, Ostrich, Oyster, and Chico Bays) and the PWN. Depths within Dyes Inlet range up to 100 feet, but are typically less than 50 feet. Hydrologic inputs to the PWN and Dyes Inlet include the tidal exchange with Sinclair Inlet and freshwater inflows from both stream and piped flows.

Aquatic habitats at the Site include those in the beach and subtidal areas within and near the former Gas Works property. Shoreline and aquatic habitat adjacent to the former Gas Works property are located within the Suquamish Tribe's Usual and Accustomed area. There are no recorded archaeological sites or historic structures at the former Gas Works property or in the immediate vicinity. However, no cultural resources surveys have been conducted on the Site or in the vicinity prior to the present project.

1.2 Proposed Study Area Boundaries

As defined in the EPA-approved Scoping Memorandum (Anchor QEA and Aspect 2015), the study area is composed of two areas: the initial study area (ISA) and the area beyond the ISA in PWN. The purpose of the ISA does not define the final marine Site boundary.

The marine ISA boundary and PWN study areas are shown in Figures B-2. The ISA is composed of intertidal and subtidal marine environment immediately adjacent to the former MGP and includes the following areas:

- Historical potential source areas associated with the MGP (including the former Gas Works Dock and the former drainage line) have been included.
- Beach sediments adjacent to the MGP that exhibited elevated polycyclic aromatic hydrocarbon (PAH) concentrations during the 2013 Time Critical Removal Action have been included.
- The offshore boundary of the ISA extends out past mid-channel in the PWN. This addresses potential migration pathways associated with groundwater and/or nonaqueous phase liquid (NAPL) migration and those associated with potential sediment transport.
- The eastern and western boundaries of the ISA extend between 500 and 1,000 feet in an east/west direction from the MGP, providing the ability to document potential transport of sediments that may have resulted from the east-west tidal currents occurring within the PWN.

The ISA includes multiple potential sources that are not associated with the historical activities at the MGP. These include multiple historical petroleum transfer docks, multiple stormwater and combined sewer overflow outfalls, and the Port Washington Marina.

As part of the RI/FS activities for sediments, there is a need to understand sediment transport process and surface water quality within the PWN. Therefore, additional sampling activities for sediments and surface water will be conducted within the PWN.

1.3 Document Organization

This SQAPP was prepared in accordance with EPA's guidance for developing Quality Assurance Project Plans (QAPPs; EPA 2004). EPA's guidance specifies four groups of information that must be included in a QAPP (Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability). Each group comprises multiple QAPP elements.

The remainder of this SQAPP is organized into the following sections:

- Section 2—Project Management
- Section 3—Data Generation and Acquisition
- Section 4—Assessments and Response Actions
- Section 5—Data Validation and Usability
- Section 6—References

2 Project Management

This section identifies key project personnel, describes the rationale for conducting the investigation studies, identifies the studies to be performed, outlines project data quality objectives (DQOs) and criteria, lists training and certification requirements for sampling personnel, and describes documentation and recordkeeping procedures. The project schedule is provided in the RI/FS Work Plan.

2.1 Project/Task Organization

Responsibilities of the team members, as well as laboratory project managers, are described in the following paragraphs.

Anchor QEA, LLC (Anchor QEA), has the primary role of Project Manager for the marine components of the RI/FS Work Plan, while Aspect Consulting, LLC (Aspect) has the primary role of Project Manager for the upland components of the RI/FS Work Plan. This document addresses only the marine components; the upland components will be addressed under separate cover in a SQAPP prepared by Aspect.

Anchor QEA Project Manager: Mark Larsen, will act as the direct line of communication between contractors, Aspect, and Cascade and is responsible for implementing activities described in this SQAPP. He will also be responsible for production of work plans, producing all project deliverables, and performing the administrative tasks needed to ensure timely and successful completion of these studies. The Project Manager will provide the overall programmatic guidance to support staff and will ensure that all documents, procedures, and project activities meet the objectives contained within this SQAPP. The Project Manager will also be responsible for resolving project concerns or conflicts related to technical matters. The Project Manager will notify Cascade of any long-term changes in core personnel.

Field Coordinator (FC): Nathan Soccorsy, is responsible for day-to-day technical and QA/QC oversight. He will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and will submit environmental samples to the designated laboratories for chemical and physical analyses.

Quality Assurance/Quality Control: Delaney Peterson, will provide QA oversight for both the field sampling and laboratory programs, ensure that samples are collected and documented appropriately, coordinate with the analytical laboratories, ensure data quality, oversee data validation, and supervise project QA coordination and data validation.

Data Manager: Laurel Menoche, will compile field observations and analytical data into a database, review the data for completeness and consistency, append the database with qualifiers assigned by the data validator, and ensure that the data obtained are in a format suitable for inclusion in the appropriate databases and delivery to EPA.

Laboratory Project Manager: The laboratory project manager(s) will be determined after laboratory selection. The laboratory manager(s) will oversee all laboratory operations associated with the receipt of the environmental samples, chemical/physical analyses, and

laboratory report preparation for this project. The Laboratory Project Manager will review all laboratory reports and prepare case narratives describing any anomalies and exceptions that occurred during analyses.

The analytical testing laboratory will be responsible for the following:

- Performing the methods outlined in this SQAPP, including those methods referenced for each analytical procedure
- Following documentation, custody, and sample logbook procedures
- Implementing QA/QC procedures required by EPA (1999, 2004, 2005), or other guidelines
- Meeting all reporting and QA/QC requirements
- Delivering electronic data files as specified in this SQAPP
- Meeting turnaround times for deliverables as described in this SQAPP

Laboratory Data Consultants is anticipated to serve as the primary contact to perform all applicable data validation.

2.2 Problem Definition/Background

This SQAPP defines the marine investigation elements required to complete an RI/FS Report. Data gaps were identified in the Scoping Memorandum and RI/FS Work Plan, which require the collection of supplemental data. This SQAPP details the collection of these data including testing of surface sediment and corresponding porewater, an evaluation of shellfish resources; an evaluation of the benthic floor (substrate, vegetation, and aquatic life); an evaluation of tidal currents to evaluate sediment stability, subsurface sediment, and surface water. Procedures for conducting the risk assessments and other tasks associated with the RI/FS are included in the RI/FS Work Plan.

2.3 Project/Task Description and Schedule

Sampling activities described in this SQAPP will be initiated following EPA's approval and as outlined in the schedule in the RI/FS Work Plan.

2.4 Data Quality Objectives and Criteria

The DQOs for this project will ensure that the data collected are of known and acceptable quality so that the project objectives described in the RI/FS Work Plan and this SQAPP are achieved. The quality of the laboratory data is assessed by precision, accuracy, representativeness, comparability, and completeness (the "PARCC" parameters). Definitions of these parameters and the applicable quality control procedures are given below. Applicable quantitative goals for these data quality parameters are listed or referenced in Table B-1.

2.4.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling, and laboratory analyses. The American Society of Testing and Materials (ASTM) recognizes two levels of precision (ASTM 2002):

- 1) Repeatability—the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory with the same apparatus under constant operating conditions.
- 2) Reproducibility—the random error associated with measurements made by different test operators in different laboratories using the same method but different equipment to analyze identical samples of test material.

In the laboratory, “within-batch” precision is measured using duplicate sample or quality control analyses and is expressed as the relative percent difference (RPD) between the measurements. The “batch-to-batch” precision is determined from the variance observed in the analyses of standard solutions or laboratory control samples from multiple analytical batches.

Field precision will be evaluated by the collection of field duplicates for chemistry samples at a frequency of one in 20 samples. Field chemistry duplicate precision will be screened against an RPD of 50%. However, no data will be qualified based solely on field homogenization duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit (MDL), where the percent error (expressed as RPD) increases. The equation used to express precision is as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:

RPD = relative percent difference

C1 = larger of the two observed values

C2 = smaller of the two observed values

2.4.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the value of results from analyses of laboratory control samples, standard reference materials, and standard solutions. In addition, matrix-spiked samples are also measured, which indicate

the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery of the measured value, relative to the true or expected value. If a measurement process produces results that are not the true or expected values, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination). Analytical laboratories utilize several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples, and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

Laboratory accuracy will be evaluated using quantitative laboratory control sample, matrix spike (MS), surrogate spike, and calibration standard recoveries compared with method-specified performance criteria or criteria listed in Table B-1. Accuracy can be expressed as a concentration compared to the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:

%R = percent recovery

S = measured concentration in the spiked aliquot

U = measured concentration in the unspiked aliquot

C_{sa} = actual concentration of spike added

Field accuracy will be controlled by adherence to sample collection procedures outlined in this SQAPP.

2.4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For the Cascade Property, the list of analytes has been identified to provide a comprehensive assessment of the known and potential contaminants at the site.

2.4.4 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats and through common traceable calibration standards and reference materials.

2.4.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{(\text{Number of acceptable data points}) \times 100}{(\text{Total number of data points})}$$

The DQO for completeness for all components of this project is 95%. Data that have been qualified as estimated because the quality control criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been rejected will not be considered valid for the purpose of assessing completeness.

2.4.6 Sensitivity

Sensitivity is a measure of analytical detection and reporting limits. In general, the lowest technologically achievable reporting limits will be targeted for this project. Analytical sensitivities must be consistent with or lower than the reporting limits listed in Tables B-2 through B-4 for non-detected results. If the target non-detected reporting limits cannot be met, the QA will be notified by the laboratory prior to proceeding with the analyses to discuss possible additional extract cleanups and/or method modifications to improve analytical sensitivities. The RI/FS Work Plan provides preliminary screening values, and future cleanup criteria will be coordinated with ongoing efforts of the Bremerton Gas Works project.

The MDL is defined as the minimum concentration at which a given target analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Laboratory practical quantitation limits or reporting limits (RLs) are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Laboratory MDLs and RLs will be used to evaluate the method sensitivity and/or applicability prior to the acceptance of a method for this program.

The sample-specific MDL and RL will be reported by the laboratory and will take into account any factors relating to the sample analysis that might decrease or increase the reporting limit (e.g., dilution factor, percent moisture, and sample mass/volume). In the event that the MDL and RL are elevated for a sample due to matrix interferences and subsequent dilution or reduction in the sample aliquot, the data will be evaluated by Anchor QEA and the laboratory to determine if an alternative course of action is required or possible. If this situation cannot be resolved readily (i.e., detection limits less than criteria are achieved), EPA will be contacted to discuss an acceptable resolution. The sample-specific RL will be the value provided in the project database.

2.5 Special Training Requirements/Certifications

For sample preparation tasks, it is important that field crews are trained in standardized data collection requirements so that the data collected are consistent among the field crews. Field crews will be comprised of individuals who are fully trained in the collection and processing of surface sediment grabs, subsurface coring, surface water collection, shellfish evaluations, video surveying, tidal current evaluations, decontamination protocols, and chain-of-custody (COC) procedures.

In addition, the 29 CFR 1910.120 Occupational Safety and Health Act (OSHA) regulations require training to provide employees with the knowledge and skills enabling them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and 8-hour refresher courses, as necessary, to meet the OSHA regulations.

2.6 Documentation and Records

This project will require central project files to be maintained at Anchor QEA. Project records will be stored and maintained in a secure manner. Each project team member is responsible for filing all necessary project information or providing it to the person responsible for the filing system. Individual team members may maintain files for individual tasks, but must provide such files to the central project files upon completion of each task. Hard copy documents will be kept on file at Anchor QEA or at a document storage facility throughout the duration of the project, and all electronic data will be maintained in the database at Anchor QEA.

2.6.1 *Field Records*

All documents generated during the field effort are controlled documents that become part of the project file. Field team members will keep a daily record of significant events, observations, and measurements on field forms specific to the collection activity. Field forms will be maintained by the FC. The sampling documentation will contain information on each sample collected and will include, at a minimum, the following information:

- Project name
- Field personnel on site
- Facility visitors
- Weather conditions
- Field observations
- Date and time sample collected
- Sampling method and description of activities
- Identification or serial numbers of instruments or equipment used

- Deviations from this SQAPP
- Meetings associated with field sampling activities

Entries for each day will begin on a new form. The person recording information must enter the date and time. In general, sufficient information will be recorded during sampling so that reconstruction of the event can occur without relying on the memory of the field personnel.

The field forms may be electronic or hand-written. If hand-written they will be on water-resistant, durable paper. Notes will be made in indelible, waterproof blue or black ink. Errors will be corrected by crossing out with a single line, dating, and initialing. Each form will be marked with the project name, number, and date. The field forms will be scanned or saved into Anchor QEA's project file directory as convenient during the sampling event or upon completion of each sampling event.

2.6.2 Analytical Records

The laboratory will retain analytical data records. Additionally, Anchor QEA will retain a copy of analytical data in its central project files. Data reporting requirements will include those items necessary to complete data validation, including copies of raw data. Elements to be reported in the laboratory data packages are listed in Section 3.5.2.6.

Instrument data shall be fully restorable at the laboratory from electronic backup. The laboratory will be required to maintain records relevant to project analyses for a minimum of 5 years. Data validation reports will be maintained in the central project files with the analytical data reports.

2.6.3 Data Reduction

Data reduction is the process by which original data (analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subject to further review by the Laboratory Manager, the Project Manager, the QA/QC Manager, and independent reviewers. Data reduction may be performed manually or electronically. If performed electronically, software used must be free from error.

3 Data Generation and Acquisition

Rationale for the sampling design and design assumptions for locating and selecting environmental samples, as well as methods and procedures for the collection of field samples, are provided in this section. Sampling will be conducted following standard procedures documented in this SQAPP. In general, all sampling procedures will comply with approved sample collection standards established for the study area.

3.1 Sampling Design—Marine Investigation

Marine data gaps identified in the scoping process are the basis of the marine investigation design. The elements of the marine investigation designed to fill the identified data gaps are summarized in Table B-5. Sampling locations, coordinates, and sample activity are summarized in Table B-6. The sequence of the investigation elements are integrated into the Marine SQAPP to inform Preliminary Remediation Goal development, Contaminant of Potential Concern (COPC) identification, risk assessment, and the definition of the nature and extent of contamination as described in Section 5 of the RI/FS Work Plan. The data acquisition program will include the following:

- **Video Surveys.** Video surveys will be conducted to identify substrate, habitat characteristics, presence of aquatic resources, and structures near the Site (Figure B-3).
- **Tidal Current Evaluation.** Near-bottom tidal currents within the aquatic areas of the Site will be characterized to assist in the evaluation of sediment stability and inform evaluations of sediment transport processes (Figure B-3).
- **Surface Sediment Investigation.** Surface sediments will be sampled and analyzed as follows:
 - a. In the marine environs immediately adjacent to the former Gas Works, 19 surface samples will be collected and analyzed for Site COPCs and alkylated PAHs (ISA-101 to ISA-119; Figure B-4).
 - b. In addition, 14 surface samples will be collected from within the ISA to define the horizontal nature and extent of contamination in surface sediments. Samples will be analyzed for Site COPCs and alkylated PAHs (ISA-01 to ISA-14; Figure B-5).
 - c. Outside of the ISA, 16 surface samples will be collected to characterize the physical qualities of sediments within the PWN (PWN-01 to PWN-16; Figure B-6), which will be used with modeled wind/wave action and measure current velocities to inform sediment transport processes (littoral drift and bed sediment mobility) within the PWN.
 - d. At five locations within the ISA, paired samples of bulk sediment and porewater will be analyzed to determine how actual PAH bioavailability compares with the bioavailability estimated using literature-derived partitioning coefficients (ISA-113 to ISA-117; Figure B-4).

- **Subsurface Sediment Investigation.** Subsurface sediment core samples will be collected at 19 locations within the ISA from the beach and subtidal areas sloping down into the PWN. The vertical distribution of Site COPCs (including the potential presence of NAPL and hydrocarbon sheen) will be evaluated in subsurface sediments (ISA-101 to ISA-119; Figure B-4).
- **Surface Water Investigation.** Surface water samples will be collected at two locations within the ISA and two background locations in the PWN and analyzed for Site COPCs (with archived analysis of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans [D/Fs]). Samples will be collected during multiple sampling events to assess potential variability in the concentrations of contaminants in surface water (PWN-07, PWN-11, ISA-101, and ISA-106; Figure B-4 and Figure B-6).
- **Beach Shellfish Surveys.** Beach surveys will be performed at seven locations within or adjacent to the ISA to evaluate the distribution of existing shellfish resources within and near the beach areas adjacent to the former Gas Works (ISA-08, ISA-113 to ISA-117, and PWN-14, Figure B-4 and Figure B-5).

The sections below provide the rationale and approach for these components of the marine investigation.

3.1.1 Video Survey Collection

Towed camera video surveys will be conducted to allow for a relative comparison of environmental conditions within and adjacent to the Site. The surveys' objective is to identify substrate types, habitat characteristics, presence of aquatic resources, and anthropogenic structures. The video surveys will be collected along 12 predefined transects in the PWN in the vicinity of the ISA (Figure B-3). Six transects each will be conducted perpendicular to and parallel with the shoreline of the PWN. The parallel video transects are positioned at the southern and northern shores at the -10 feet mean lower low water (MLLW) and -20 feet MLLW contours (Figure B-3), through the deeper channel area adjacent to the former Gas Works, and over the shallower area in the central channel. One of the perpendicular transects is positioned through the slope adjacent to the former Gas Works and two are positioned to the east and west in the PWN. After the video surveys are complete, the locations of the transects will be plotted on a figure. The videos will be reviewed to qualitatively determine the substrate type, habitat characteristics, presence of aquatic resources, and other significant observations, and the results will be logged. This survey will yield an interpretative figure, which will present the video survey findings.

3.1.2 Tidal Currents Evaluation

Tidal surveys will be conducted by a qualified contractor along transects at the locations shown in Figure B-3. A vessel-mounted acoustic doppler current profiler will be used to measure current velocity along station transects over the course of a daily tide cycle. Measurements will be collected in both directions (i.e., back and forth) across each transect location to decrease any directional bias in the data. Sampling will be performed during a period of high tidal exchange (between a high tide of at least mean higher high water and a low tide below MLLW). A tidal exchange that includes a relatively high-energy and average

exchange event will be targeted to capture peak and average velocities. Current velocity measured at two depth profiles (near-bottom and mid-water column) along each transect will be used to indicate potential impacts of current velocity on sediment stability within the ISA and PWN.

3.1.3 Surface Sediment Investigation

Surface sediment samples will be collected to determine the lateral nature and extent of Site-related contamination, chemical fate and transport, determination of Site COPCs, and relative bioavailability of Site-related contamination. All surface sediments will be collected from a depth 0 to 4 inches below the mudline that typically comprises the bioactive zone. Consistent with previous Site-related investigations, intertidal sediment locations within the ISA will be collected by hand during low tide. All subtidal surface sediment samples will be collected using a power actuated Van Veen grab sampler.

The surface sediment immediately adjacent to the former Gas Works operation will be characterized by 17 sampling locations in transects down the slope toward PWN channel and 2 locations immediately to the west of the slope (for spatial coverage in the ISA) within the marina (total of 19 locations; ISA-101 to ISA-119; Figure B-4). These 19 surface sediment locations are collocated with subsurface cores for vertical delineation (see Section 3.1.5).

Fourteen additional surface sediment samples will be collected to characterize surface sediment nature and extent of contamination within the ISA (ISA-01 to ISA-14; Figure B-5). These include a sample from the marina to the west, two intertidal locations to the east, four subtidal locations at the base of the slope, and seven subtidal locations distributed throughout the ISA.

Surface sediments within the ISA will be analyzed for Site COPCs (Table B-2) except as modified for below. These include total organic carbon [TOC], cyanide, weak acid dissociable (WAD) cyanide sulfide, hexavalent chromium, grain size, metals, PAHs, semivolatile organic compounds, organochlorine pesticides, and polychlorinated biphenyl (PCB) Aroclors. Tiered analyses will be conducted for volatile organic compounds (VOCs), D/Fs, and PCB congeners as summarized below.

VOCs

- Sediment will be sampled and analyzed for VOCs in the presence of the following screening criteria: hydrocarbon sheens, strong hydrocarbon odors, or elevated photoionization detector readings relative to typical ambient readings that day.
- A minimum of five samples will be collected and analyzed; at least two of the five representing “clean” samples (no screening hits). Clean samples should represent sediments of similar physical characteristics to those with positive screening results.
- Example interpretation is as follows: 1) if seven samples have positive screening results, then a total of nine samples would be analyzed (seven positives and two clean); 2) If two samples have positive screening results, then a total of five samples would be analyzed (two positives and three clean); and 3) if all screened samples are non-detects, five of those samples would be analyzed.

D/Fs

- Sediment for potential D/F analysis will be collected in the field and archived (frozen) in the laboratory.
- Upon receipt of preliminary analytical data, samples with detections of PCB Aroclors, chlorinated phenols, or chlorinated pesticides will be analyzed for D/Fs.
- A minimum of five samples will be collected and analyzed; at least two of the five representing “clean” samples (no screening hits). Clean samples should represent sediments of similar physical characteristics to those with positive screening results.
- Example interpretation are as follows: 1) if seven samples have positive screening results, then a total of nine samples would be analyzed (seven positives and two clean); 2) If two samples have positive screening results, then a total of five samples would be analyzed (two positives and three clean); and 3) if all screened samples are non-detects, five of those samples would be analyzed.

PCB Congeners

- Sediment for potential PCB congeners will be collected in the field and archived (frozen) in the laboratory.
- Upon receipt of preliminary analytical data, samples with detections of PCB Aroclors will be analyzed for PCB congeners. If PCB Aroclor concentrations are relatively low-level then samples representative of the detections will be selected for PCB congener analysis.

The five intertidal locations (ISA-113, -114, -115, -116, and -117) will also be tested to determine the relative bioavailability of PAHs through ex situ porewater solid-phase microextraction (SPME) testing (Table B-4). This testing is described further in Section 3.4.2.

Surface sampling at 16 locations outside the ISA will be conducted to evaluate sediment transport processes (littoral drift and bed load) within the PWN (PWN-01 to PWN-16; Figure B-6). Sediment sampling will be conducted at 11 intertidal (subject to littoral drift) and 6 subtidal locations (bedded sediment mobility) for physical testing parameters: TOC, TS, and grain size. Sediment volume will be collected and archived for potential chemical analysis, if necessary, to inform recontamination potential when coupled with sediment transport evaluation results.

3.1.4 Beach Shellfish Surveys

Additional information is required to document the habitat conditions and the types of seafood species present within PWN near the ISA. Shellfish surveys will be conducted based on Washington Department of Fish and Wildlife (WDFW) methods (Campbell 1996) using a systematic random sampling design. Shellfish surveys will be conducted at seven locations within and adjacent to the ISA (ISA-08, ISA-113 to ISA-117, and PWN-14; Figure B-4 and Figure B-5). These data will provide a baseline survey of the current shellfish species presence within the ISA.

3.1.5 Subsurface Sediment Investigation

Subsurface core sampling will be conducted to determine the vertical nature and extent of Site COPCs (including NAPL and sheen). The subsurface explorations will be advanced at 17 sampling locations along transects aligned down the slope from the former Gas Works operation and 2 locations immediately west of the slope within the marina (total of 19 locations; ISA-101 to ISA-119; Figure B-4). The subsurface sampling area includes the intertidal areas where Site COPCs are known to be elevated and in locations of historical dock structures. The core program design is of sufficient density to evaluate migration pathways described in Section 4.2.1 of the RI/FS Work Plan. To evaluate potential release pathways to the PWN, the deepest core in each transect targets the -20 feet MLLW elevation to acquire subsurface sediments below the approximate elevation of the channel depth of -25 feet MLLW.

At each location, a 15-foot long vibracore will be advanced until it can penetrate no further. Each core will be logged and sectioned into 1- or 2-foot intervals for testing based on visual observation and stratigraphy. No sample interval will be greater than 2 feet in length. Sample intervals will start at roughly 4 inches below mudline to account for the collocated surface grab. Initially, two subsurface core intervals will be submitted for a full suite of analyses at each location:

- In cores with visual contamination (such as odor, sheen, staining, etc.), a core interval will be selected for analysis to characterize the contaminated zone.
- An underlying visually clean interval will be selected for analysis in an attempt to find the uncontaminated elevation.
- In cores without visual contamination, two intervals will be processed immediately underlying the surficial sediments approximately 4 inches below mudline. The remainder of the core will be sectioned and archived for additional analyses, if required.
- Analyses will include TOC, cyanide, WAD cyanide sulfide, hexavalent chromium, grain size, metals, organochlorine pesticides, PAHs, PCB Aroclors, and semivolatile organic compounds (SVOCs) (Table B-2). Extra sediment volume will be archived for additional analyses, if required.
- Subsurface sediment will be sampled and analyzed for VOCs where there are observations of hydrocarbon sheens, hydrocarbon odors, or elevated photoionization detector readings. Similar to the surface sediment sampling, a minimum of five samples will be collected and analyzed, at least two of the five representing “clean” samples (e.g., interval with no sheen, odor or field screening indications). Clean samples should represent sediments of similar physical characteristics to those where samples were collected due to observations or field screening indications.
- The remainder of the core will be sectioned and archived for additional analyses, if required.

If NAPL or other visible contamination is identified during core processing at the subsurface bounding locations, ISA-101, ISA-102 through ISA-105, ISA-106, ISA-112, ISA-117,

ISA-118, and ISA-119, an additional core will be collected offset from the initial location. If necessary, the exact placement will be made by the FC and communicated to EPA or their designee. If additional cores are necessary, they will be advanced and processed as described previously in this section.

3.1.6 Surface Water Investigation

Surface water will be sampled and analyzed at four locations within the ISA and surrounding area to evaluate concentrations of Site COPCs from the Site and PWN (PWN-07, PWN-11, ISA-101, and ISA-106; Figures B-4 and Figure B-6). These data will be collected to determine the potential of Site-related releases to surface water that may be influencing near-field water quality and compared to water quality data from outside of the ISA. To assess potential season and weather condition variability, quarterly sampling events (four) will be conducted. One of the sampling events will target a rain event, and another will target a relatively dry period.

Surface water will be collected from an appropriately outfitted sampling vessel using a 5-liter Van Dorn sampler oriented horizontally, and in situ water quality data will be collected using a Hydrolab for direct instantaneous physical characteristic measurement. At each station, samples from the following two depths within the water column will be collected: 3 feet below the water surface and 3 feet above the mudline. The surface water samples will be submitted for a full suite of analyses including PAHs (including alkylated), metals, SVOCs, VOCs, PCB Aroclors, and pesticides. The direct Hydrolab readings for dissolved oxygen, pH, salinity, and temperature will be recorded at each depth.

These data will allow a quantitative comparison of surface water quality between the ISA and the PWN. If elevated Site-related COPC concentrations are detected at the Site, these data will support exposure human health and ecological risk assessments.

3.1.7 Additional Sampling

The Risk Assessment Technical Memorandum (Work Plan Section 5.3.1) will describe the scope and methodology for collection and analysis of marine tissue samples to support the HHRA and ERA. Additional sampling may be required as described in the Work Plan including additional sediment collection, contingent sediment bioassay testing, contingent sediment geochronology, and/or treatability testing. If additional testing is necessary, an addendum will be submitted detailing sampling, processing, and analytical methods prior to the collection of this additional data.

3.1.8 Results Memoranda

Anchor QEA will prepare a Data Memorandum for the marine portion of the project. Aspect will compile this memorandum with results from the upland portion of the investigation into final documents for submittal to EPA for review and approval. This memorandum will

document the results of the sampling and analysis program and, at a minimum, will contain the following information:

- A statement of the purpose of the investigation.
- A summary of the field sampling, field data, and laboratory analytical procedures (reference will be made to the final SQAPP). Deviations, whether intended or unintended, will be documented. Failure to meet sampling or data quality objectives of sufficient magnitude that lead to rejection of results will be well documented, as necessary.
- Sampling locations will be presented on associated figures. Coordinates will be reported in an accompanying table for all stations. All geographical coordinates submitted to EPA will be in the North American Datum (NAD) 83, Washington State Plane, North Zone.
- Chemical analyses results data tables summarizing chemical and conventional variables and all pertinent QA/QC data.
- An interpretation of the results against surrounding area data and risk-based values.
- Copies of complete laboratory data packages as appendices or attachments.
- Copies of applicable sections of the field log as appendices or attachments.
- Copies of validation reports and/or findings.

3.2 Sampling Methods

This section describes sampling methods and includes sample identification, station positioning, surface sediment collection and processing, subsurface sediment collection and processing, surface water collection and water quality monitoring, evaluation of shellfish resources, video survey, and evaluation of tidal currents.

3.2.1 Sample Identification

Each sample will be assigned a unique alphanumeric identifier according to the following method:

- Each sample ID will be identified by the overall site (BGW) and location within the site (either ISA or PWN).
 - The sample collection method will be identified by one of the following sets of two letters: SG for surface sediment grab, SC for subsurface sediment core, or SW for surface water.
 - Station numbers will be added after the collection method identifier.
 - The date is MMDDYYYY format and will be appended to the end of the sample ID.

- Subsurface sediment sample IDs will have the depth interval (in feet) below mudline surface added after the station number (i.e., 1-2).
- Surface water sample IDs will have the collection depth (S = 3 feet below surface; B = 3 feet above bottom) added after the station number.
- Example sample identification nomenclature include:
 - BGW-ISA-SS05-070117: Surface sediment sample collected from station ISA-05 on July 1, 2017.
 - BGW-ISA-SC102-1-2-070117: Subsurface sediment sample collected at a depth interval of 1 to 2 feet below mudline at station ISA-102 on July 1, 2017.
 - BGW-PWN-SW07B-070117: Surface water sample collected 3 feet above mudline at station PWN-07 on July 1, 2017.
- A field duplicate collected from a sample will be identified by the addition of 1000 to the sample number. A duplicate sample of the above surface sediment example would be BGW-ISA-SS1005-070117.

Rinsate blank samples will use the overall site identifier followed by “RB,” the collection method, and date. The resulting nomenclature of a rinsate blank of the decontaminated surface grab sample processing equipment collected on July 1, 2017, would be BGW-RB-SS-070117.

3.2.2 Station Positioning

Station locations are shown in Figures B-3 through B-6. Horizontal positioning will be determined in the field by digital global positioning system (DGPS) based on target coordinates. Target coordinates are provided in Table B-6. The horizontal datum will be NAD 83, Washington State Plane, North Zone. Measured geographical coordinates for station positions will be recorded and reported to the nearest 0.01 second. In addition, state plane coordinates will be reported to the nearest foot. The DGPS accuracy is less than 1 meter and generally less than 30 centimeters, depending on the satellite coverage and the number of data points collected.

The vertical elevation of each sediment station will be measured using a fathometer or lead line and converted to MLLW elevation. Tidal elevations will be determined based on tide predictions made for the National Oceanic and Atmospheric Administration’s tide gauge station number 9445901, located in Dyes Inlet in Tracyton, Washington.

3.2.3 Video Survey

To conduct video surveys, an underwater video camera will be deployed from an appropriately outfitted vessel, using a winch and lowered to approximately 1 foot above the sediment surface. The camera will be lowered or raised, as needed, depending upon the geography and visibility, and towed at a speed of 1 to 2 knots along a transect at each station. GPS coordinates will be recorded along the length of the transect.

Following collection, the as-collected towed video transects will be plotted. The videos will be viewed to qualitatively identify general substrate types (e.g., grain size assessment if visible), general habitat characteristics (e.g., rocky or vegetated surface), the presence of aquatic resources (e.g., fish or eel grass), or other significant observations (e.g., outfalls, structures, or sunken barges), and the results will be logged. The survey will yield an interpretative figure that will present the video survey findings.

3.2.4 Evaluation of Tidal Currents

Tidal surveys will be conducted by a qualified contractor. A vessel-mounted acoustic doppler current profiler (ADCP) will be used to measure current velocity along station transects over the course of a daily tide cycle. Equipment will be calibrated to manufacturer standards and set to measure the currents throughout the water column. Measurements will be collected in both directions (i.e., back and forth) across each transect location to decrease any directional bias in the data. Vessel speed will be regulated to a maximum of 1 meter per second to reduce velocity prediction errors.

Current velocity measured at two depth profiles (near-bottom and mid-water column) along each transect will be used to indicate potential impacts of current velocity on sediment stability within the ISA and PWN.

3.2.5 Intertidal Surface Sediment Collection and Processing

Surface sediments (0- to 4-inch sampling depth) will be collected from each of the ISA intertidal sampling locations shown in Figure B-4 and in accordance with the sampling summary in Tables B-5 and B-6. Consistent with previous intertidal beach sampling at the Site (Anchor QEA, 2013), each sample will represent a localized station composite of five equal volume aliquots. One aliquot will be collected at the target location, and the other four aliquots will be collected approximately 3 feet from the target location at the approximate four points of the compass. Sediments will be collected with decontaminated stainless steel trowels into decontaminated stainless steel bowls, homogenized, and placed into appropriate sample containers as listed in Table B-7.

Intertidal surface sediments (0- to 4-inch sampling depth) within the PWN (Figure B-6) may be collected from using the methods described above or as described in Section 3.2.6, depending on access and tidal conditions at the time of collection.

3.2.6 Subtidal Surface Sediment Collection and Processing

Surface sediment samples will be collected from the 0- to 4-inch biologically active zone at locations shown in Figures B-4 through Figure B-6 and in accordance with the sampling summary in Tables B-5 and B-6. A hydraulic Van Veen sampling device will be used to collect subtidal surface sediment samples. The grab sampler will be lowered from a cable wire at an approximate speed of 0.3 feet per second. When the sampler reaches the mudline, the cable will be drawn taut and DGPS measurements recorded. Each surface grab sample will be retrieved aboard the vessel and evaluated for the following acceptance criteria:

- Overlying water is present and has low turbidity

- Adequate penetration depth is achieved
- Sampler is not overfilled
- Sediment surface is undisturbed
- No signs of winnowing or leaking from sampling device

Grab samples not meeting these criteria will be rejected and returned as near to the location of sample collection as possible. The vessel will be adjusted so as not to collect from the same exact location. The process will be repeated until criteria have been met. Deployments will be repeated within a 20-foot radius of the proposed sample location. If adequate penetration is not achieved after three attempts, a shallower depth of penetration will be accepted and noted in the field notebook. The sampler will be decontaminated between stations.

The following information will be recorded in the electronic field application, field log sheet, sediment sampling form, and/or the field notebook:

- Date, time, and name of person logging sample
- Weather conditions
- Sample location number and coordinates
- Project designation
- Depth of water at the location and surface elevation
- Sediment penetration and depth
- Sediment sample interval (if applicable)
- Sample recovery
- Whether the grab was accepted

Once a grab is accepted, overlying water will be siphoned off and a decontaminated stainless steel trowel, spoon, or equivalent will be used to collect the aliquot for volatile organic compound analysis by placing a representative amount from the upper 4 inches directly into the sample jar, ensuring there is no headspace, and capping the jar. Then, a decontaminated stainless steel trowel, spoon, or equivalent will be used to collect only the upper 4 inches of sediment from inside the sampler without collecting any material that is touching the sidewalls. Debris and materials more than 0.5 inch in diameter will be omitted from sample containers. Sediment will be homogenized in a pre-cleaned stainless steel bowl or tub.

In addition to sample collection, surface sediment processing will include physical characterization in accordance with the visual-manual description procedure (Method ASTM D-2488 modified). This information will be hand-written or electronically recorded on a sediment sampling form. Physical characterization includes the following elements:

- Grain size distribution
- Density and consistency
- Plasticity

- Color and moisture content
- Biological structures (e.g., shells, tubes, macrophytes, and bioturbation)
- Presence of debris and quantitative estimate (e.g., wood chips or fibers, concrete, and metal debris)
- Presence of oily sheen
- Odor (e.g., hydrogen sulfide and hydrocarbon)

Surface sediment samples collected for chemical and physical analyses will be securely packed and delivered to Analytical Resources, Inc. (ARI) in Tukwila, Washington, or an equivalent EPA-accredited laboratory or laboratories. Archived samples will be held at the primary laboratory in frozen storage.

3.2.7 Beach Shellfish Survey Methods

Consistent with the WDFW method, the intertidal surface sample locations will be the target starting point for the shellfish survey. Stations will be approached on foot, and the surveys will be conducted during a 4-hour window centered around a low tide (-1.0 MLLW or lower). Shellfish will be harvested in accordance with the randomization procedures for identification, enumeration, and measurement (Campbell 1996).

At each target station, a sampling zone will be delineated. The “productive” area of the beach (the area containing significant clam resource) will be delineated parallel and extending to the water line. Test holes will be dug to determine the top of the clam band, and surveyor flags or similar will be used to mark the boundary. A 20-foot perpendicular sampling area will be laid out using the target sampling station as the center point. GPS coordinates will be recorded in the field notebook to note the boundaries, and photographs will be taken to provide a visual record.

Once established, the area of the sampling zone will be calculated and the number of samples will be determined. A minimum of one sample for every 4,000-square-foot block is required. Transects will be laid out perpendicular to the water line. A random number generator will be used to establish the distance (in feet) for placement of the first transect from either perpendicular boundary of the sampling zone. Another random number will be selected for placement of the first sampling point along the transect, starting from the top of the clam band. A surveyor flag or similar will be used to mark the sampling point, and GPS coordinates will be recorded in the field notebook. The second sample (and all others along the transect) will be collected at a pre-determined number of feet along the transect (based on the calculated number of samples needed). GPS coordinates will be recorded at each sampling point.

The next transect (and all remaining transects) will be placed at a fixed distance apart as determined by the block size. The first sample on every transect will be a random number of feet from the top of the clam band, and remaining samples will be placed at fixed intervals.

At each sampling point, a 1-foot hoop will be placed over the surveyor flag, and a shovel will be used to collect all sediment to a depth of 1 foot within the hoop. Recovered clams will be sorted and placed in buckets for processing. Other shellfish (such as shore crabs, oysters, and

mussels) found within the sampling hoop will be noted on data sheets. Clams will be identified to species level, if possible, photographed, and enumerated by species/taxonomic group. Survey data will be used to identify presence of aquatic and shellfish resources within the ISA and PWN and to inform the risk assessment.

3.2.8 Subsurface Sediment Collection

Subsurface sediments will be collected from a sufficiently outfitted marine sampling vessel. Subsurface sediment samples will be collected using a vibracore advanced to 15 feet or refusal depth. Vibracore sediment samples will be collected in the following manner:

1. The vessel will maneuver to the proposed sample location.
2. A clean core tube the length of the desired penetration depth will be secured to the vibratory assembly and deployed from the vessel.
3. The cable umbilical to the vibrator assembly will be drawn taut and perpendicular, as the core rests on the bottom sediment.
4. The location of the umbilical hoist will be measured and recorded by the location control personnel, and depth to sediment will be measured with a survey tape attached to the head assembly.
5. A 4-inch-diameter thin-walled aluminum tube will be vibratory-driven into the sediment using two counter-rotating vibrating heads.
6. A continuous core sample will be collected to the designated coring depth or until refusal.
7. The depth of core penetration will be measured and recorded.
8. The vibrator will be turned off, and the core barrel will be extracted from the sediment using the winch.
9. While suspended from the A-frame, the assembly and core barrel will be sprayed off and then placed on the vessel deck.
10. The length of recovered sediment will be recorded.

Cores will be evaluated to determine if they meet acceptability requirements for the project. Acceptance criteria for sediment core samples are as follows:

- Overlying water is present and the surface is intact
- The core tube appears intact without obstruction or blocking
- Recovery is greater than 50% of drive length.

If sample acceptance criteria are not achieved, the sample will be rejected unless modified acceptance criteria are approved by the FC. At locations where sediment substrate is predominantly gravel and cobble, a lesser recovery percentage may be accepted on a case-by-case basis in coordination with the FC.

Anchor QEA personnel will record field conditions and drive notes on an electronic or hand-written standard core log. Logs will include the following information:

- Water depth at each station using lead line at point of sampling station
- Coordinates of each station as determined by DGPS
- Date and time of collection of each sediment core sample
- Names of field personnel collecting and handling the samples
- Observations made during sample collection, including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- The sample station identification
- Length and depth intervals of each core section and estimated recovery for each sediment sample as measured from MLLW
- Qualitative notation of apparent resistance of the sediment column to coring (how the core drove)
- Any deviation from the approved SQAPP

Once the core samples are deemed acceptable, the cutterhead will be removed, and a cap will be placed over the end of the tube and secured firmly in place with duct tape. The core tube will then be removed from the sampler, and the other end of the core will be capped and taped. The core tube will be labeled with permanent black pen and scribed with the location ID and an arrow pointing to the top of core. The cores will then be cut into appropriate lengths for transport to the processing location. The cores will be sealed tightly enough to prevent leakage or disturbance during transport to the processing station. Cores will be transported daily to the processing area.

3.2.9 Subsurface Sediment Processing Methods

Subsurface cores will be processed at a suitable upland facility. Transported cores will be handled consistent with ASTM procedures (ASTM D 4220) and stored upright and cool until processed. The core caps will be removed, and the core will be cut longitudinally using electric sheers or similar. The core will be split into two halves for processing.

Prior to sampling, Anchor QEA field staff will take color photographs and record a sediment description of each core on a standard core processing log. The following parameters will be noted:

- Sample recovery
- Physical soil description in accordance with ASTM procedures (ASTM D 2488 and ASTM D 2487—Unified Soil Classification System) including soil type, density/consistency of soil, and color
- Odor (e.g., hydrogen sulfide and petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris

- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of NAPL

Initially, two intervals from each core will be submitted for immediate analysis, and all other intervals will be archived for future analysis if needed, as described in Section 3.1.5.

Samples for each interval will be placed in a decontaminated stainless steel bowl, homogenized using a decontaminated stainless steel mixing spoon, and then spooned into laboratory-supplied jars for analyses. Sample handling requirements are presented in Table B-7. Subsurface sediment samples collected for chemical and physical analyses will be securely packed and delivered to ARI or an equivalent EPA-accredited laboratory. Archived samples will be held at the laboratory in frozen storage.

3.2.10 Surface Water Collection and Water Quality Monitoring

Surface water collection will occur from an appropriately outfitted sampling vessel. Surface water will be collected at two depths within the water column, 3 feet below the water surface and 3 feet above the mudline, at each station. Sampling will occur once per quarter, resulting in a total of four sampling events. A rain event and relatively dry period will be targeted for two of the sampling events.

Water samples will be collected with a 5-liter Van Dorn sampler oriented horizontally. The sampler will be attached to a rope line with both ends propped open and then lowered to the desired depth. A messenger weight will subsequently be released for travel down the line to close the sampler ends, capturing the water at the target depth. Once back onboard, the sample will be gently poured into the appropriate pre-cleaned, pre-labeled sample containers, placed in coolers filled with ice or equivalent, and maintained at 2-6 degrees Celsius (°C). Additionally, in situ water quality parameters will be measured using a Hydrolab MS5 multi-probe sonde or equivalent sonde equipped with sensors to measure dissolved oxygen, pH, temperature, and salinity. The sonde will be lowered to the desired sampling depth using a lead line to estimate depth. Measurements will be recorded on electronic or hand-written field forms.

Water samples collected for chemical and physical analyses will be securely packed and delivered to ARI or an equivalent EPA-accredited laboratory.

3.3 Field Communication Plan

EPA will be informed of scheduled and completed field activities. Deviations from the Work Plan, or other issues warranting EPA attention, will be communicated to EPA immediately. During field sampling activities, preliminary draft field forms and data (including draft collection logs, draft core processing logs, and photos) will be posted within 24 hours to a password-controlled website for review by Cascade and EPA project teams. These preliminary draft work products will undergo QA/QC after posting and may be revised prior

to inclusion in AOC-required work products. The website will be set up, tested, and approved by EPA and Cascade prior to beginning field work.

Information relevant to field decision-making, such as preliminary analytical data (including pre-validated laboratory reports, summary data tables, and/or figures, as appropriate), maps, cross-sections, or other analyses, will also be posted to the website as needed, and Cascade and EPA project team members will be informed via email.

Conditions requiring immediate EPA notification include the following:

- Deviations from the Work Plan
- Unanticipated Site conditions that affect the scope of work
- Conditions exhibiting an immediate threat to human health or the environment
- Conditions that result in significant schedule delays (e.g., equipment breakdowns)

A weekly status call during extended periods of field activities (i.e., longer than 1 week) will be scheduled with EPA and Cascade project teams. Additional meetings or teleconferences to discuss field activities and preliminary data may be scheduled as needed.

3.4 Sample Handling Requirements

This section addresses the sampling program requirements for field decontamination, investigation-derived waste management, sample custody, and sample shipping requirements.

3.4.1 Field Decontamination Procedures

Sample containers, instruments, working surfaces, and other items that may come into contact with sediment sample material must meet high standards of cleanliness. All equipment and instruments used that are in direct contact with the sediment collected for analysis must be made of glass, stainless steel, high density polyethylene, or polytetrafluoroethylene. These items will be cleaned prior to each day's use and between sampling or compositing events. Decontamination of all items will follow Puget Sound Estuary Program protocols. The decontamination procedure is:

1. Pre-wash rinse with tap water or site water.
2. Wash with a solution of tap water and Alconox soap (use a brush).
3. Rinse with tap water.
4. Rinse three times with distilled water.
5. Cover (no contact) all decontaminated items with aluminum foil.
6. Store in a clean, closed container; for bowls, store inverted on a foil-covered surface for next use.

3.4.2 Investigation-derived Waste Management

Any sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site unless sheens or NAPL are identified during collection. Sediment remaining after surface sediment sample processing will be gently placed back onto the sediment surface at the collection location. Sediment remaining after subsurface core processing (landside) is considered investigation-derived waste (IDW) and will be collected in 5-gallon buckets or 55-gallon drums. The buckets or drums will be located in a secure area and appropriately labeled. A composite sample of IDW will be collected and chemically analyzed to obtain representative data for sediment disposal profiling.

Any surface water remaining in the grab sampler after the sample containers have been filled will be drained overboard before proceeding to the next station.

All disposable sampling materials and personal protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy-duty garbage bags or other appropriate containers. Disposable supplies will be placed in a normal refuse container for disposal as solid waste.

3.4.3 Sample Custody and Shipping Requirements

Samples are considered to be in one's custody if they are in the custodian's possession or view; in a secured location (under lock) with restricted access; or in a container that is secured with official seals such that the sample cannot be reached without breaking the seals.

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample ID will be listed on an electronic or hand-written COC form the day it is collected. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, and then dating and initialing the change. Blank lines and spaces on the COC form will be lined-out, dated, and initialed by the individual maintaining custody.

A COC form will accompany each shipment of samples to the analytical laboratories. Each person who has custody of the samples will ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files.

All samples will be shipped or hand-delivered to the analytical laboratory no later than the day after collection. Samples collected on Friday may be held until the following Monday for shipment, provided that this does not jeopardize any hold time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container holding the samples for analysis will be hand-delivered the day of sample collection, couriered, or shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the FC will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of containers shipped and the airbill tracking numbers for those containers.

- Coolant ice will be sealed in separate plastic bags and placed in the shipping containers.
- Individual samples will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
- If the samples are transferred using a commercial shipping company, the following procedures will be followed:
 - The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
 - The shipping waybill number will be documented on all COC forms accompanying the samples.
 - COC forms will be enclosed in a plastic bag and placed inside the cooler.
 - A minimum of two signed and dated COC seals will be placed on adjacent sides of each cooler prior to shipping.
 - Each cooler will be wrapped securely with strapping tape, labeled "Glass – Fragile" and "This End Up," and be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the COC form. Upon receipt of samples at the laboratory, the person receiving the sample will sign the COC form. The shipping container seals will be broken (if applicable) and the receiver will record the condition of the samples on a sample receipt form. COC forms will be used internally in the lab to track sample handling and final disposition.

3.5 Laboratory Methods

This section includes methods for analytical chemistry for sediment, water, and porewater samples.

3.5.1 Analytical Methods – Sediment and Water Chemistry

This section summarizes the target physical and chemical analyses for the various media sampled. All sample analyses will be conducted in accordance with EPA-approved methods and this SQAPP. Prior to analyses, all samples will be maintained according to the appropriate holding times and temperatures for each analysis (Table B-7). Analytes, analytical methods, and target detection limits for chemical and physical testing are presented in Tables B-2 through B-4. The analytical laboratory will prepare a detailed report in accordance with this SQAPP.

Prior to the analysis of the samples, the laboratory will calculate MDLs for each analyte of interest, where applicable. MDLs will be below the values specified in Tables B-2 through B-4 if technically feasible. To achieve the required detection limits, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract. The modifications must be approved by EPA prior to implementation. All laboratory instruments used in the analyses will be calibrated to the RLs specified in Tables B-2 through B-4 to avoid reporting any false positives due to background noise.

Chemical/physical testing will be conducted at SGS (SPME), ARI or equivalent EPA-accredited laboratories. All chemical and physical testing will adhere to the most recent EPA QA/QC procedures outlined in the approved analytical methods and in this SQAPP. If more current analytical methods are available, the laboratories will use them.

In completing chemical analyses for this project, the contract laboratories are expected to meet the following minimum requirements:

- Adhere to the methods outlined in this SQAPP, including methods referenced for each analytical procedure (Tables B-2, B-3, and B-4)
- Deliver electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures discussed in this SQAPP including DQOs, laboratory quality control requirements, and performance evaluation testing requirements
- Notify the project QA/QC Manager of any SQAPP QA/QC problems when they are identified to allow for quick resolution
- Allow laboratory and data audits to be performed, if deemed necessary

3.5.2 Analytical Methods—Porewater

To determine the relative ex situ bioavailability of PAHs in surface sediment porewater at five intertidal stations, SPME fibers will be inserted into each sample at Anchor QEA's geochemical laboratory in Portland, Oregon. The SPME will equilibrate with the porewater over a period of approximately 1 month under laboratory conditions with mild agitation. Performance reference compounds will be pre-spiked into the SPME fibers to confirm that equilibrium conditions are achieved. The SPME fibers will then be removed from the sediments and submitted for analytical testing to SGS for PAHs and alkylated PAHs or an equivalent laboratory. SPME analytes and methods are listed in Table B-4.

3.6 Quality Assurance/Quality Control

Field and laboratory activities will be conducted in such a manner that the results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from

the protocols developed for EPA SW-846 (1986), the EPA Contract Laboratory Program (EPA 1999, 2004, 2005), and the cited methods.

3.6.1 Field Quality Control

Anchor QEA personnel will identify and label samples in a consistent manner to ensure that field samples are traceable. Labels should be used in conjunction with the COCs and this SQAPP to provide all information necessary for the laboratory to conduct required analyses properly. QA samples will be collected in the field to ensure project DQOs are met. Samples will be placed in appropriate containers and preserved for shipment to the laboratory in accordance with the requirements presented in Table B-7.

3.6.1.1 Field Quality Assurance Sampling

Field QA procedures will consist of following procedures for acceptable practices for collecting and handling of samples. This also includes periodic and routine equipment inspection.

Field QA samples will be collected along with the environmental samples. Field QA samples are useful in identifying possible problems resulting from sample collection or sample processing in the field. The collection of field QA samples includes equipment rinsate blanks and field duplicates. Rinsate blanks will be collected at a frequency of one per collection method per event. If target analytes are detected in the rinsate blank at levels above the RLs, decontamination procedures will be reviewed and modified and additional blanks collected until the source of contamination has been eliminated or reduced to acceptable levels. Field duplicates will be collected at a frequency of one per sampling event or one in 20 sample locations processed (whichever is more frequent).

Field QA samples will also include the collection of additional sample mass or volume as required to ensure that the laboratory has sufficient sample mass or volume to run the matrix-specified analytical QA/QC (matrix duplicate [MD]/MS/MS duplicate [MSD]) samples for analyses as specified in Table B-8. Additional sample mass or volume to meet this requirement will be collected at a frequency of one per sampling event or one in 20 samples processed, whichever is more frequent. The samples designated for MD/MS/MSD analyses should be clearly marked on the COC.

All field QA samples will be documented on the field forms and verified by the QA/QC Manager or designee.

3.6.1.2 Sample Containers

Sample containers and preservatives will be provided by the laboratory. The laboratory will maintain documentation certifying the cleanliness of bottles and the purity of preservatives provided. Container guidelines are listed in Table B-7. Actual sampling containers may be revised as directed by the analytical laboratory.

3.6.1.3 Sample Identification and Labels

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project name
- Sample identification
- Date and time of sample collection
- Preservative type (if applicable)
- Analysis to be performed

3.6.2 Laboratory Quality Control

Laboratory quality control procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, matrix spikes, surrogate spikes (for organic analyses), and method blanks. A summary of the DQOs is provided in Table B-1. QA/QC sample frequencies are provided in Table B-8.

An analyst will review the results of the quality control samples from each sample group immediately after a sample group has been analyzed. The quality control sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

3.6.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. Calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analyses of samples. Continuing calibration verifications (CCV) will be analyzed at method-required frequencies to track instrument performance. The frequency of CCVs varies with method. For gas chromatography (GC)/mass spectrometer methods, one will be analyzed every 12 hours. For GC, metals, and inorganic methods, one will be analyzed for every 10 field samples analyzed and at the end of each run. If the continuing calibration is out of control, the analysis will be terminated until the source of the control failure is eliminated or reduced to meet control specifications, which may include analyzing a new initial calibration. Any project samples analyzed while the instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to continuing calibration verification at the instrument for each type of applicable analysis.

3.6.2.2 Laboratory Duplicates/Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as a separate sample.

3.6.2.3 Matrix Spikes and Matrix Spike Duplicates

Analyses of MS samples provide information on the extraction efficiency of the method on the sample matrix, as well as any interferences introduced by the sample matrix. By performing duplicate MS (MSD) analyses, information on the precision of the method is also provided.

3.6.2.4 Method Blanks

Method blanks are prepared and analyzed in the same manner as project samples to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the method reporting limit of any single target analyte/compound. If a laboratory method blank exceeds this criterion for any analyte/compound, and the concentration of the analyte/compound in any of the samples is less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced. Affected samples should be reprepared and reanalyzed, if possible.

3.6.2.5 Laboratory Control Samples

Laboratory control samples are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The laboratory control sample is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of the sample, MS, and method blank. The laboratory control sample will provide information on the precision of the analytical process, and when analyzed in duplicate, will provide accuracy information as well.

3.6.2.6 Laboratory Deliverables

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. The analytical laboratory will be required, where applicable, to report the following:

- **Project Narrative.** This summary, in the form of a cover letter, will include a discussion of any problems encountered during analyses. This summary should include (but not be limited to) QA/QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.
- **Chain-of-Custody Records.** Legible copies of the COC forms will be provided as part of the data package. This documentation will include the time of receipt and

condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented on a sample receipt form. The form must include sample shipping container temperatures measured at the time of sample receipt.

- **Sample Results.** The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
 - Field sample identification code and the corresponding laboratory identification code
 - Sample matrix
 - Date of sample preparation/extraction
 - Date and time of analysis
 - Mass and/or volume used for preparation and analysis
 - Final dilution or concentration factors for the sample
 - Identification of the instrument used for analysis
 - MDLs and method RLs accounting for sample-specific factors (e.g., dilution and TS)
 - Analytical results with reporting units identified
 - Data qualifiers and their definitions
 - An electronic data deliverable with data in a format specified in advance by Anchor QEA
- **QA/QC Summaries.** This section will contain the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results. No recovery or blank corrections will be made by the laboratory. The required summaries are as follows (additional information may be requested):
 - **Calibration Data Summary.** This summary will report the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, and retention time for each analyte will be listed, as appropriate. Calibration results for standards will be documented to indicate instrument sensitivity.
 - **Internal Standard Area Summary.** The stability of internal standard areas will be reported.
 - **Method Blank Analysis.** The method blank analysis associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
 - **Surrogate Spike Recovery.** All surrogate spike recoveries for organic analyses will be reported. The name and concentration of all compounds

added, percent recoveries, and range of acceptable recoveries will be provided.

- **MS Recovery.** MS recovery data for all applicable analyses will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be listed. The percent recoveries and RPD values for MS duplicate analyses will be reported.
- **Matrix Duplicate.** The RPD values for matrix duplicate analyses will be reported.
- **Laboratory Control Sample.** Laboratory control sample recovery data will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be included. The percent recoveries and RPD values for laboratory control sample duplicate analyses will be included.
- **Relative Retention Time.** Relative retention times of each analyte detected in the samples for both primary and conformational analyses will be reported.
- **Original Data.** Legible copies of the original data generated by the laboratory will include the following information:
 - Sample extraction, preparation, and cleanup logs including methods used
 - Instrument analysis logs for all instruments used on days of calibration and sample analyses
 - Calculation worksheets as applicable
 - Ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
 - Copies of full scan chromatograms and quantitation reports for GC and/or GC/mass spectrometer analyses of samples, standards, blanks, calibrations, spikes, replicates, and reference materials
 - Enhanced spectra of detected compounds with associated best-match spectra for each sample

3.7 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

This section describes procedures for testing, inspection, and maintenance of field and laboratory equipment.

3.7.1 Field Instruments/Equipment

In accordance with the QA program, Anchor QEA shall maintain an inventory of field instruments and equipment. The frequency and types of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The Anchor QEA FC will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. The equipment maintenance

information will be documented in the instrument's calibration log. The frequency of maintenance is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and the recommendations of the manufacturer. Detailed information regarding the calibration and frequency of equipment calibration is provided in each specific manufacturer's instruction manuals.

All maintenance records will be verified prior to each sampling event. The FC will be responsible for verifying that required maintenance has been performed prior to using the equipment in the field. For this project, maintenance inspections will include the following activities:

- The subcontractor responsible for navigation will confirm proper operation of the navigation equipment daily. This verification may consist of internal diagnostics or visiting a location with known coordinates to confirm the coordinates indicated by the navigation system.
- The winch line, as well as sediment and water samplers, will be inspected daily for fraying, misalignment, loose connections, and any other applicable mechanical problems.
- The underwater camera will be tested prior to deployment to ensure no electrical or mechanical problems exist.
- The subcontractor responsible for the tidal current surveying will ensure ADCPs are in good working order prior to use in the field.

Any problems will be noted in the field logbook and corrected prior to continuing sampling operations.

3.7.2 Laboratory Instruments/Equipment

In accordance with the QA program, the laboratory shall maintain an inventory of instruments and equipment, and the frequency of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The laboratory preventative maintenance program, as detailed in the laboratory QA Plan, is organized to maintain proper instrument and equipment performance and to prevent instrument and equipment failure during use. The program considers instrumentation, equipment, and parts that are subject to wear, deterioration, or other changes in operational characteristics, the availability of spare parts, and the frequency at which maintenance is required. Any equipment that has been overloaded, mishandled, gives suspect results, or has been determined to be defective will be taken out of service, tagged with the discrepancy noted, and stored in a designated area until the equipment has been repaired. After repair, the equipment will be tested to ensure that it is in proper operational condition. The client will be promptly notified in writing if defective equipment casts doubt on the validity of analytical data. The client will also be notified immediately regarding any delays due to instrument malfunctions that could impact holding times.

Laboratories will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. Maintenance records will be checked according to

the schedule on an annual basis and recorded by laboratory personnel. The Laboratory QA/QC Manager or designee shall be responsible for verifying compliance.

3.7.2.1 Laboratory Instrument/Equipment Calibration

As part of their quality control program, laboratories perform two types of calibrations. A periodic calibration is performed at prescribed intervals (e.g., balances, drying ovens, refrigerators, and thermometers), and operational calibrations are performed daily at a specified frequency or prior to analysis (i.e., initial calibrations) according to method requirements. Calibration procedures and frequency are discussed in the laboratory QA Plan. Calibrations are discussed in the laboratory standard operating procedures (SOPs) for analyses.

The Laboratory QA/QC Manager will be responsible for ensuring that the laboratory instrumentation is calibrated in accordance with specifications. Implementation of the calibration program will be the responsibility of the respective laboratory Group Supervisors. Recognized procedures (EPA, ASTM, or manufacturer's instructions) will be used when available.

Physical standards (i.e., weights or certified thermometers) will be traceable to nationally recognized standards such as the National Institute of Standards and Technology (NIST). Chemical reference standards will be NIST standard reference materials or vendor-certified materials traceable to these standards.

The calibration requirements for each method and respective corrective actions will be accessible, either in the laboratory SOPs or in the laboratory's QA Plan for each instrument or analytical method in use. All calibrations will be preserved on electronic media.

3.8 Inspection/Acceptance of Supplies and Consumables

Inspection and acceptance of field supplies, including laboratory-prepared sampling bottles, will be performed by the FC. All primary chemical standards and standard solutions used for this project, either in the field or laboratory, will be traceable to documented, reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

3.9 Non-direct Measurements

Existing data suitable for use in the in the production of the RI/FS report has been identified in the Scoping Memorandum (in prep) and RI/FS Work Plan.

3.10 Data Management

Field data sheets will be checked for completeness and accuracy by the FC prior to delivery to the Data Manager. Data generated in the field will be documented on electronic or hard copy and provided to the Data Manager, who is responsible for the data entry into the

database. All manually-entered data will be verified by a second party. Field documentation will be filed in the main project file after data entry and verification are complete.

Laboratory data will be provided to the Data Manager in the EQuIS electronic format. Laboratory data that is electronically provided and loaded into the database will undergo a check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of all manually-entered data will be verified by a second party. Data tables and reports will be exported from EQuIS to Microsoft Excel tables.

Final validated lab analytical data shall be verified for its intended use. All final lab data will be provided to the EPA Regional Project Manager and the contractor Project Manager in the Region 10 Electronic Data Deliverable standard superset universal format as defined in the Region 10 Data Management Plan Appendix B (EPA, 2014). All project data including field collection, locational, monitoring, custody/shipment, and final lab results will be recorded in Scribe by Contractor/Sampling Organization. Requirements for submission and documentation are identified in the Region 10 Data Management Plan and associated appendices (EPA, 2014). GIS deliverables and supporting data (Appendix E) along with the Scribe deliverables (.bac file/Scribe.net) will be provided to the EPA Regional Project Manager, RSCC and GIS staff within 60 days of project completion.

4 Assessments and Response Actions

Once data are received from the laboratory, a number of quality control procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

4.1 Compliance Assessments

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted as part of this study. However, all laboratory audit reports will be made available to the project QA/QC Manager upon request. The laboratory is required to have written procedures addressing internal QA/QC. These procedures have been submitted and the project QA/QC Manager will review them to ensure compliance with this SQAPP. The laboratory must ensure that personnel engaged in analytical tasks have appropriate training. The laboratory will provide written details of any and all method modifications planned prior to project commencement.

4.2 Response and Corrective Actions

The following paragraphs identify the responsibilities of key project team members and actions to be taken in the event of an error, problem, or non-conformance to protocols identified in this document.

4.2.1 Field Activities

The FC will be responsible for correcting equipment malfunctions during the field sampling effort. The project QA/QC Manager will be responsible for resolving situations identified by the FC that may result in non-compliance with this SQAPP. All corrective measures will be immediately documented in the field logbook.

4.2.2 Laboratory

The laboratory is required to comply with its SOPs. The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SQAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

The Laboratory Project Manager will be notified immediately if any quality control sample exceeds the project-specified control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. If the laboratory internal corrective action does not resolve the non-conformance, the Laboratory Project Manager will notify the QA/QC Manager. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and re-extraction) will be submitted with the data package in the form of a cover letter.

4.3 Reports to Management

QA reports to management include verbal status reports, data validation reports, and final project reports. These reports shall be the responsibility of the QA/QC Manager.

5 Data Validation and Usability

This section describes the processes that will be used to review project data quality.

5.1 Data Review, Validation, and Verification

During the validation process, analytical data will be evaluated for project, method, and laboratory quality control compliance, and their validity and applicability for program purposes will be determined. Based on the findings of the validation process, data validation qualifiers may be assigned. The validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved, as needed.

5.2 Validation and Verification Methods

Data validation includes signed entries by the field and laboratory technicians on field data sheets and laboratory datasheets, respectively; review for completeness and accuracy by the FC and Laboratory Manager; review by the Data Manager for outliers and omissions; and the use of quality control criteria to accept or reject specific data. All data will be entered into the EQuIS database and a raw data file printed or exported. A second data manager or designee will perform a cursory verification of the database raw data file. If errors are found, further verification will be performed to ensure that all data are accurate. Any errors found will be corrected in the database.

All laboratory data will be reviewed and verified to determine whether DQOs have been met and that appropriate corrective actions have been taken, when necessary. The project QA/QC Manager or designee will be responsible for the final review of data generated from analyses of samples.

The first level of review will take place in the laboratory as the data are generated. The laboratory department manager or designee will be responsible for ensuring that the data generated meet minimum QA/QC requirements and that the instruments were operating under acceptable conditions during generation of data. DQOs will also be assessed at this point by comparing the results of quality control measurements with pre-established criteria as a measure of data acceptability.

The analysts and/or laboratory department manager will prepare a preliminary quality control checklist for each parameter and for each sample delivery group (SDG) as soon as analysis of an SDG has been completed. Any deviations from the DQOs listed on the checklist will be brought to the attention of the Laboratory Manager to determine whether corrective action is needed and to determine the impact on the reporting schedule.

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Stage 2B validation (EPA 2009) will be conducted on 90% of the data and Stage 4 validation (EPA 2009) on 10%. Data validation will be conducted by a reviewer using current National

Functional Guidelines data validation requirements (EPA 1999, 2004, 2005, 2008) by considering the following information, as applicable:

- COC documentation and sample receipt condition
- Holding times
- Instrument performance checks
- Initial calibrations
- Continuing calibrations
- Method blanks
- Surrogate recoveries
- Internal standard recoveries
- Detection limits
- Reporting limits
- Laboratory control samples
- MS/MSD samples
- Field and laboratory duplicates
- Rinsate blanks
- Standard reference material results
- Raw data review

The data will be validated in accordance with the project-specific DQOs described above, analytical method criteria, and the laboratory's internal performance standards based on their SOPs.

5.3 Reconciliation with User Requirements

The QA/QC Manager will review data after each survey to determine if DQOs have been met. If data do not meet the project's specifications, the QA/QC Manager will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors and will suggest corrective action. Retraining, revision of techniques, or replacement of supplies/equipment should correct the problem; if not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA/QC Manager will recommend appropriate modifications. Any revisions will require approval by EPA.

6 References

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TABLES

Table B-1
Data Quality Objectives

Matrix	Parameter	Precision	Accuracy	Completeness
Sediment	TS/Grain size	± 20% RPD	NA	95%
	TOC/DOC	± 30% RPD	65-135% R	95%
	Total/WAD Cyanide	± 30% RPD	75-125% R	95%
	Sulfide	± 30% RPD	75-125% R	95%
	Metals	± 30% RPD	75-125% R	95%
	VOCs/SVOCs/PAHs	± 35% RPD	50-150% R	95%
	PCB Aroclors/Pesticides	± 35% RPD	50-150% R	95%
	PCDD/PCDF and PCB Congeners	± 35% RPD	50-150% R	95%
Surface Water	TSS	± 20% RPD	NA	95%
	TOC/DOC	± 20% RPD	70-130% R	95%
	Total/WAD Cyanide	± 20% RPD	80-120% R	95%
	Metals	± 30% RPD	75-125% R	95%
	VOCs/SVOCs/PAHs	± 35% RPD	50-150% R	95%
	PCB Aroclors/Pesticides	± 35% RPD	50-150% R	95%

Notes:

DOC - dissolved organic carbon

PCB - polychlorinated biphenyl

PAH - polycyclic aromatic hydrocarbon

PCDD/PCDF - polychlorinated dibenzodioxin/polychlorinated dibenzofuran

R - recovery

RPD - relative percent difference

SVOCs - semivolatile organic compounds

TOC - total organic carbon

TS - total solids

TSS - total suspended solids

VOCs - volatile organic compounds

WAD - weak acid dissociable

Table B-2
Sediment Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a	PRGs
Conventionals (mg/kg)			
Cyanide, WAD	SM4500-CN	0.25	--
Cyanide, total	SM4500-CN	0.25	--
Sulfide	PSEP	1.0	--
Conventionals (%)			
Grain size	PSEP	0.1	--
Total organic carbon	PSEP	0.1	--
Total solids	SM2540G	0.1	--
Metals (mg/kg)			
Antimony	6020A	0.2	--
Arsenic	6020A	0.2	57
Beryllium	6020A	0.2	--
Cadmium	6020A	0.1	5.1
Chromium	6020A	0.5	260
Chromium III	Calculated	0.5	--
Chromium VI	7196A	0.1	--
Copper	6020A	0.5	390
Lead	6020A	0.1	450
Mercury	7471B	0.025	0.41
Nickel	6020A	0.5	20.9
Selenium	6020A	0.5	2.0
Silver	6020A	0.2	6.1
Thallium	6020A	0.2	--
Zinc	6020A	4.0	410
Parent polycyclic aromatic hydrocarbons (µg/kg)			
1-Methylnaphthalene	8270D-SIM	5.0	
Acenaphthene	8270D-SIM	5.0	500
Acenaphthylene	8270D-SIM	5.0	1300
Anthracene	8270D-SIM	5.0	960
Benzo(a)anthracene	8270D-SIM	5.0	1300
Benzo(a)pyrene	8270D-SIM	5.0	1600
Benzo(e)pyrene	8270D-SIM	5.0	--
Benzo(b)fluoranthene	8270D-SIM	5.0	10400
Benzo(g,h,i)perylene	8270D-SIM	5.0	670
Benzo(j)fluoranthene	8270D-SIM	5.0	--
Benzo(k)fluoranthene	8270D-SIM	5.0	240
Chrysene	8270D-SIM	5.0	1400
Dibenzo(a,h)anthracene	8270D-SIM	5.0	230
Fluoranthene	8270D-SIM	5.0	1700
Fluorene	8270D-SIM	5.0	540
Indeno(1,2,3-c,d)pyrene	8270D-SIM	5.0	600
Naphthalene	8270D-SIM	5.0	2100
Perylene	8270D-SIM	5.0	--
Phenanthrene	8270D-SIM	5.0	1500
Pyrene	8270D-SIM	5.0	2600
Total Benzofluoranthenes (b,j,k)	8270D-SIM	15	--
Total HPAH	8270D-SIM	5.0	12000
Total LPAH	8270D-SIM	5.0	5200
Total PAH	8270D-SIM	5.0	4022
Alkylated polycyclic aromatic hydrocarbons (µg/kg)			
C1-Naphthalenes	8270D-SIM	5.0	--
C2-Naphthalenes	8270D-SIM	5.0	--
C3-Naphthalenes	8270D-SIM	5.0	--
C4-Naphthalenes	8270D-SIM	5.0	--
C1-Fluorenes	8270D-SIM	5.0	--
C2-Fluorenes	8270D-SIM	5.0	--
C3-Fluorenes	8270D-SIM	5.0	--
C1-Phenanthrenes/Anthracenes	8270D-SIM	5.0	--
C2-Phenanthrenes/Anthracenes	8270D-SIM	5.0	--
C3-Phenanthrenes/Anthracenes	8270D-SIM	5.0	--
C4-Phenanthrenes/Anthracenes	8270D-SIM	5.0	--
C1-Fluoranthenes/Pyrenes	8270D-SIM	5.0	--
C1-Benzanthracenes/Chrysenes	8270D-SIM	5.0	--
C2-Benzanthracenes/Chrysenes	8270D-SIM	5.0	--
C3-Benzanthracenes/Chrysenes	8270D-SIM	5.0	--
C4-Benzanthracenes/Chrysenes	8270D-SIM	5.0	--
Semivolatile organic compounds (µg/kg)			
1,2,4,5-Tetrachlorobenzene	8270D	20	47000
1,2,4-Trichlorobenzene	8270D	20	31
1,2-Dichlorobenzene	8270D	20	35
1,3-Dichlorobenzene	8270D	20	842
1,4-Dichlorobenzene	8270D	20	110
2,2'-Oxybis (1-chloropropane)	8270D	20	--

Table B-2
Sediment Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a	PRGs
2,3,4,6-Tetrachlorophenol	8270D	20	284
2,4,5-Trichlorophenol	8270D	100	819
2,4,6-Trichlorophenol	8270D	100	2650
2,4-Dichlorophenol	8270D	100	117
2,4-Dimethylphenol	8270D	100	29
2,4-Dinitrophenol	8270D	200	6.21
2,4-Dinitrotoluene	8270D	100	--
2,6-Dinitrotoluene	8270D	100	--
2-Chloronaphthalene	8270D	20	417
2-Chlorophenol	8270D	20	344
2-Methylphenol (o-Cresol)	8270D	20	670
2-Nitroaniline	8270D	100	--
2-Nitrophenol	8270D	20	--
3,3'-Dichlorobenzidine	8270D	100	2060
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	8270D	20	--
3-Methylphenol (m-Cresol)	8270D	20	--
3-Nitroaniline	8270D	100	--
4-Bromophenyl-phenyl ether	8270D	20	1230
4-Chloro-3-methylphenol	8270D	100	388
4-Chloroaniline	8270D	100	146
4-Methylphenol (p-Cresol)	8270D	20	--
4-Nitroaniline	8270D	20	--
4-Nitrophenol	8270D	100	13.3
Acetophenone	8270D	20	--
Aniline	8270D	100	--
Atrazine	8270D	20	6.62
Benzaldehyde	8270D	20	--
Benzidine	8270D	20	--
Benzoic acid	8270D	20	--
Benzyl alcohol	8270D	20	--
Biphenyl (1,1'-Biphenyl)	8270D	20	1220
bis(2-Chloroethoxy)methane	8270D	20	3520
bis(2-Chloroethyl)ether	8270D	20	1300
bis(2-Ethylhexyl)phthalate	8270D	50	--
Butylbenzyl phthalate	8270D	20	63
Caprolactam	8270D	20	540
Dibenzofuran	8270D	20	--
Diethyl phthalate	8270D	20	200
Dimethyl phthalate	8270D	20	71
Di-n-butyl phthalate	8270D	20	1400
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	8270D	20	104
Di-n-octyl phthalate	8270D	20	6200
Hexachlorobenzene	8270D	20	22
Hexachlorocyclopentadiene	8270D	100	139
Hexachloroethane	8270D	20	804
Isophorone	8270D	20	432
Nitrobenzene	8270D	20	--
n-Nitrosodimethylamine	8270D	40	--
n-Nitrosodi-n-propylamine	8270D	20	--
n-Nitrosodiphenylamine	8270D	20	28
Pentachlorophenol	8270D	100	360
Phenol	8270D	20	420
Volatile organic compounds (µg/kg)^b			
1,1,1,2-Tetrachloroethane	8260C	1.0	--
1,1,1-Trichloroethane	8260C	1.0	856
1,1,2,2-Tetrachloroethane	8260C	1.0	202
1,1,2-Trichloroethane	8260C	1.0	570
1,1,2-Trichlorotrifluoroethane (Freon 113)	8260C	2.0	--
1,1-Dichloroethane	8260C	1.0	0.575
1,1-Dichloroethene	8260C	1.0	2780
1,2,3-Trichlorobenzene	8260C	5.0	858
1,2,3-Trichloropropane	8260C	2.0	--
1,2,4-Trimethylbenzene	8260C	1.0	31
1,2-Dibromo-3-chloropropane	8260C	5.0	--
1,2-Dichloroethane	8260C	1.0	260
1,2-Dichloroethene, cis-	8260C	1.0	--
1,2-Dichloroethene, trans-	8260C	1.0	1050
1,2-Dichloropropane	8260C	1.0	333
1,3,5-Trimethylbenzene (Mesitylene)	8260C	1.0	--
1,3-Dichloropropane	8260C	1.0	--
1,3-Dichloropropene, cis-	8260C	1.0	--
1,3-Dichloropropene, trans-	8260C	1.0	--

Table B-2
Sediment Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a	PRGs
1,4-Dichloro-2-butene, trans-	8260C	1.0	--
1,4-Dioxane	8260C	1.0	--
2-Butanone (MEK)	8260C	5.0	42.4
2-Chlorotoluene	8260C	1.0	--
2-Hexanone (Methyl butyl ketone)	8260C	5.0	58.2
4-Chlorotoluene	8260C	1.0	--
4-Isopropyltoluene (4-Cymene)	8260C	1.0	--
Acetone	8260C	5.0	--
Acrolein	8260C	50.0	0.0015
Acrylonitrile	8260C	5.0	1.2
Benzene	8260C	1.0	137
Bromobenzene	8260C	1.0	--
Bromochloromethane	8260C	1.0	--
Bromodichloromethane	8260C	1.0	--
Bromoform (Tribromomethane)	8260C	1.0	1310
Bromomethane (Methyl bromide)	8260C	2.0	1.37
Carbon disulfide	8260C	1.0	0.851
Carbon tetrachloride (Tetrachloromethane)	8260C	1.0	7240
Chlorobenzene	8260C	1.0	162
Chloroethane	8260C	1.0	--
Chloroform	8260C	1.0	121
Chloromethane	8260C	1.0	--
Cyclohexane	8260C	1.0	--
Dibromochloromethane	8260C	1.0	--
Dibromomethane	8260C	1.0	--
Dichlorodifluoromethane	8260C	1.0	--
Dichloromethane (Methylene chloride)	8260C	2.0	159
Ethylbenzene	8260C	1.0	305
Ethylene dibromide (1,2-Dibromoethane)	8260C	1.0	--
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	8260C	5.0	11
Isopropylbenzene (Cumene)	8260C	1.0	86
Methyl acetate	8260C	1.0	--
Methyl iodide (Iodomethane)	8260C	1.0	--
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	8260C	5.0	25.1
Methyl tert-butyl ether (MTBE)	8260C	1.0	--
n-Butylbenzene	8260C	1.0	--
n-Propylbenzene	8260C	1.0	--
o-Xylene	8260C	1.0	--
sec-Butylbenzene	8260C	1.0	--
Styrene	8260C	1.0	7070
tert-Butylbenzene	8260C	1.0	--
Tetrachloroethene (PCE)	8260C	1.0	--
Toluene	8260C	1.0	190
Total xylene (reported, not calculated)	8260C	2.0	1090
Total Xylene	8260C	1.0	--
Trichloroethene (TCE)	8260C	1.0	8950
Trichlorofluoromethane (Fluorotrichloromethane)	8260C	1.0	--
Vinyl acetate	8260C	5.0	13
Vinyl chloride	8260C	1.0	202
Pesticides (µg/kg)			
2,4'-DDD (o,p'-DDD)	8081B	1.0	--
2,4'-DDE (o,p'-DDE)	8081B	1.0	--
2,4'-DDT (o,p'-DDT)	8081B	1.0	--
4,4'-DDD (p,p'-DDD)	8081B	1.0	--
4,4'-DDE (p,p'-DDE)	8081B	1.0	--
4,4'-DDT (p,p'-DDT)	8081B	1.0	--
Aldrin	8081B	0.5	--
Chlordane, alpha- (Chlordane, cis-)	8081B	0.5	--
Chlordane, beta- (Chlordane, trans-)	8081B	0.5	--
Dieldrin	8081B	1.0	--
Endosulfan sulfate	8081B	1.0	--
Endosulfan-alpha (I)	8081B	0.5	--
Endosulfan-beta (II)	8081B	1.0	--
Endrin	8081B	1.0	--
Endrin aldehyde	8081B	1.0	--
Endrin ketone	8081B	1.0	--
Heptachlor	8081B	0.5	--
Heptachlor epoxide	8081B	0.5	--
Hexachlorocyclohexane, alpha (BHC)	8081B	0.5	--
Hexachlorocyclohexane, beta- (BHC)	8081B	0.5	--
Hexachlorocyclohexane, delta (BHC)	8081B	0.5	--
Hexachlorocyclohexane, gamma- (BHC) (Lindane)	8081B	0.5	--
Methoxychlor	8081B	5.0	--

Table B-2
Sediment Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a	PRGs
Mirex	8081B	1.0	--
Oxychlordane	8081B	1.0	--
Nonachlor, cis-	8081B	1.0	--
Nonachlor, trans-	8081B	1.0	--
Toxaphene	8081B	25.0	--
Polychlorinated biphenyl Aroclors (µg/kg)			
Aroclor 1016	8082A	4.0	--
Aroclor 1221	8082A	4.0	--
Aroclor 1232	8082A	4.0	--
Aroclor 1242	8082A	4.0	--
Aroclor 1248	8082A	4.0	--
Aroclor 1254	8082A	4.0	--
Aroclor 1260	8082A	4.0	--
Aroclor 1262	8082A	4.0	--
Aroclor 1268	8082A	4.0	--
Total PCB Aroclors	8082A	4.0	--

Table B-2
Sediment Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a	PRGs
Polychlorinated biphenyl congeners (ng/kg) ^c			
PCB-001 - 209	1668C	10	--
Dioxin/Furans (ng/kg) ^d			
2,3,7,8-TCDD	1613B	1.0	--
1,2,3,7,8-PeCDD	1613B	1.0	--
1,2,3,4,7,8-HxCDD	1613B	1.0	--
1,2,3,6,7,8-HxCDD	1613B	1.0	--
1,2,3,7,8,9-HxCDD	1613B	1.0	--
1,2,3,4,6,7,8-HpCDD	1613B	1.0	--
OCDD	1613B	1.0	--
2,3,7,8-TCDF	1613B	1.0	--
1,2,3,7,8-PeCDF	1613B	1.0	--
2,3,4,7,8-PeCDF	1613B	1.0	--
1,2,3,4,7,8-HxCDF	1613B	1.0	--
1,2,3,6,7,8-HxCDF	1613B	1.0	--
1,2,3,7,8,9-HxCDF	1613B	1.0	--
2,3,4,6,7,8-HxCDF	1613B	1.0	--
1,2,3,4,6,7,8-HpCDF	1613B	1.0	--
1,2,3,4,7,8,9-HpCDF	1613B	1.0	--
OCDF	1613B	1.0	--

Notes:

^aEstimated PQL was obtained from Analytical Resources Inc. PQLs may vary based on lab selection. In some instances lab reporting limits may exceed the PQL due to matrix interferences, which will be addressed as part of data validation.

^bAnalyses of VOCs in surface and subsurface sediments are contingent on field screening observations as described in Section 3.1.3 and 3.1.5.

^cAnalyses of PCB congeners in surface sediments are contingent on receipt of preliminary analytical results for PCB Aroclors as described in Section 3.1.3.

^dAnalyses of D/F congeners in surface sediments are contingent on receipt of preliminary analytical data of PCB Aroclors, chlorinated phenols, and chlorinated pesticides as described in Section 3.1.3.

- µg/kg - micrograms per kilogram
- HPAH - high-molecular-weight polycyclic aromatic hydrocarbon
- LPAH - low-molecular-weight polycyclic aromatic hydrocarbon
- mg/kg - milligrams per kilogram
- NA - not applicable to this analyte
- ng/kg - nanograms per kilogram
- PAH - polycyclic aromatic hydrocarbon
- PCDD/PCDF - polychlorinated dibenzo-p-dioxins/ polychlorinated dibenzofurans
- PRG - Preliminary Remediation Goal
- PSEP - Puget Sound Estuary Program
- PQL - Practical Quantitation Limit
- WAD - weak acid dissociable

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
Field Measurements		
Salinity	N/A	N/A
Conductivity	N/A	N/A
Temperature	N/A	N/A
pH	N/A	N/A
Dissolved oxygen	N/A	N/A
Conventionals (mg/L)		
TSS	SM 2540D	1.0
Total organic carbon	9060 Mod	1.5
Dissolved organic carbon	9060 Mod	1.5
Total cyanide	SM 4500-CN	0.005
WAD cyanide	SM 4500-CN I	0.005
Metals (µg/L)		
Antimony	6020A	0.2
Arsenic	6020A	0.2
Beryllium	6020A	0.2
Cadmium	6020A	0.1
Chromium	6020A	0.5
Chromium III	6020A	0.5
Chromium VI	7196A	0.01
Copper	6020A	0.5
Lead	6020A	0.1
Mercury	7470A	0.02
Nickel	6020A	0.5
Selenium	6020A	0.5
Silver	6020A	0.2
Thallium	6020A	0.2
Zinc	6020A	4.0
Polycyclic aromatic hydrocarbons (µg/kg)		
1-Methylnaphthalene	8270D/SIM	0.1
Acenaphthene	8270D/SIM	0.1
Acenaphthylene	8270D/SIM	0.1
Anthracene	8270D/SIM	0.1
Benzo(a)anthracene	8270D/SIM	0.1
Benzo(a)pyrene	8270D/SIM	0.1
Benzo(e)pyrene	8270D/SIM	0.1
Benzo(b)fluoranthene	8270D/SIM	0.1
Benzo(g,h,i)perylene	8270D/SIM	0.1
Benzo(k)fluoranthene	8270D/SIM	0.1
Chrysene	8270D/SIM	0.1
Dibenz(a,h)anthracene	8270D/SIM	0.1
Fluoranthene	8270D/SIM	0.1
Fluorene	8270D/SIM	0.1

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
Indeno(1,2,3-cd)pyrene	8270D/SIM	0.1
Naphthalene	8270D/SIM	0.1
Phenanthrene	8270D/SIM	0.1
Perylene	8270D/SIM	0.1
Pyrene	8270D/SIM	0.1
Total Benzofluoranthenes (b,j,k)	Calculated	--
Total HPAH	Calculated	--
Total LPAH	Calculated	--
Total PAH	Calculated	--
Alkylated polycyclic aromatic hydrocarbons (µg/L)		
C1-Naphthalenes	8270D-SIM	0.1
C2-Naphthalenes	8270D-SIM	0.1
C3-Naphthalenes	8270D-SIM	0.1
C4-Naphthalenes	8270D-SIM	0.1
C1-Fluorenes	8270D-SIM	0.1
C2-Fluorenes	8270D-SIM	0.1
C3-Fluorenes	8270D-SIM	0.1
C1-Phenanthrenes/Anthracenes	8270D-SIM	0.1
C2-Phenanthrenes/Anthracenes	8270D-SIM	0.1
C3-Phenanthrenes/Anthracenes	8270D-SIM	0.1
C4-Phenanthrenes/Anthracenes	8270D-SIM	0.1
C1-Fluoranthenes/Pyrenes	8270D-SIM	0.1
C1-Benzanthracenes/Chrysenes	8270D-SIM	0.1
C2-Benzanthracenes/Chrysenes	8270D-SIM	0.1
C3-Benzanthracenes/Chrysenes	8270D-SIM	0.1
C4-Benzanthracenes/Chrysenes	8270D-SIM	0.1
Semivolatile organic compounds (µg/L)		
1,2,4,5-Tetrachlorobenzene	8270D	1.0
1,2,4-Trichlorobenzene	8270D	1.0
1,2-Dichlorobenzene	8270D	1.0
1,3-Dichlorobenzene	8270D	1.0
1,4-Dichlorobenzene	8270D	1.0
2,2'-Oxybis (1-chloropropane)	8270D	1.0
2,3,4,6-Tetrachlorophenol	8270D	1.0
2,4,5-Trichlorophenol	8270D	5.0
2,4,6-Trichlorophenol	8270D	3.0
2,4-Dichlorophenol	8270D	3.0
2,4-Dimethylphenol	8270D	3.0
2,4-Dinitrophenol	8270D	20.0
2,4-Dinitrotoluene	8270D	3.0
2,6-Dinitrotoluene	8270D	3.0
2-Chloronaphthalene	8270D	1.0
2-Chlorophenol	8270D	1.0

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
2-Methylphenol (o-Cresol)	8270D	1.0
2-Nitroaniline	8270D	3.0
2-Nitrophenol	8270D	3.0
3,3'-Dichlorobenzidine	8270D	5.0
3-Methylphenol & 4-Methylphenol (m&p-Cresol)	8270D	2.0
3-Methylphenol (m-Cresol)	8270D	2.0
3-Nitroaniline	8270D	3.0
4-Bromophenyl-phenyl ether	8270D	1.0
4-Chloro-3-methylphenol	8270D	3.0
4-Chloroaniline	8270D	5.0
4-Methylphenol (p-Cresol)	8270D	2.0
4-Nitroaniline	8270D	3.0
4-Nitrophenol	8270D	10.0
Acetophenone	8270D	TBD
Aniline	8270D	1.0
Atrazine	8270D	TBD
Benzaldehyde	8270D	TBD
Benzidine	8270D	--
Benzoic acid	8270D	20.0
Benzyl alcohol	8270D	2.0
Biphenyl (1,1'-Biphenyl)	8270D	TBD
bis(2-Chloroethoxy)methane	8270D	1.0
bis(2-Chloroethyl)ether	8270D	1.0
bis(2-Ethylhexyl)phthalate	8270D	3.0
Butylbenzyl phthalate	8270D	1.0
Caprolactam	8270D	TBD
Dibenzofuran	8270D	1.0
Diethyl phthalate	8270D	1.0
Dimethyl phthalate	8270D	1.0
Di-n-butyl phthalate	8270D	1.0
Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	8270D	10.0
Di-n-octyl phthalate	8270D	1.0
Hexachlorobenzene	8270D	1.0
Hexachlorocyclopentadiene	8270D	5.0
Hexachloroethane	8270D	2.0
Isophorone	8270D	1.0
Nitrobenzene	8270D	1.0
n-Nitrosodimethylamine	8270D	3.0
n-Nitrosodi-n-propylamine	8270D	1.0
n-Nitrosodiphenylamine	8270D	1.0
Pentachlorophenol	8270D	10.0
Phenol	8270D	1.0
Volatile organic compounds (µg/L)^b		

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
1,1,1,2-Tetrachloroethane	8260C	0.20
1,1,1-Trichloroethane	8260C	0.20
1,1,2,2-Tetrachloroethane	8260C	0.20
1,1,2-Trichloroethane	8260C	0.20
1,1,2-Trichlorotrifluoroethane (Freon 113)	8260C	0.20
1,1-Dichloroethane	8260C	0.20
1,1-Dichloroethene	8260C	0.20
1,2,3-Trichlorobenzene	8260C	0.50
1,2,3-Trichloropropane	8260C	0.50
1,2,4-Trimethylbenzene	8260C	0.20
1,2-Dibromo-3-chloropropane	8260C	0.50
1,2-Dichloroethane	8260C	0.20
1,2-Dichloroethene, cis-	8260C	0.20
1,2-Dichloroethene, trans-	8260C	0.20
1,2-Dichloropropane	8260C	0.20
1,3,5-Trimethylbenzene (Mesitylene)	8260C	0.20
1,3-Dichloropropane	8260C	0.20
1,3-Dichloropropene, cis-	8260C	0.20
1,3-Dichloropropene, trans-	8260C	0.20
1,4-Dichloro-2-butene, trans-	8260C	1.00
1,4-Dioxane	8260C	TBD
2-Butanone (MEK)	8260C	5.00
2-Chlorotoluene	8260C	0.20
2-Hexanone (Methyl butyl ketone)	8260C	5.00
4-Chlorotoluene	8260C	0.20
4-Isopropyltoluene (4-Cymene)	8260C	0.20
Acetone	8260C	5.00
Acrolein	8260C	5.00
Acrylonitrile	8260C	1.00
Benzene	8260C	0.20
Bromobenzene	8260C	0.20
Bromochloromethane	8260C	0.20
Bromodichloromethane	8260C	0.20
Bromoform (Tribromomethane)	8260C	0.20
Bromomethane (Methyl bromide)	8260C	1.00
Carbon disulfide	8260C	0.20
Carbon tetrachloride (Tetrachloromethane)	8260C	0.20
Chlorobenzene	8260C	0.20
Chloroethane	8260C	0.20
Chloroform	8260C	0.20
Chloromethane	8260C	0.50
Cyclohexane	8260C	TBD
Dibromochloromethane	8260C	0.20

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
Dibromomethane	8260C	0.20
Dichlorodifluoromethane	8260C	0.20
Dichloromethane (Methylene chloride)	8260C	1.00
Ethylbenzene	8260C	0.20
Ethylene dibromide (1,2-Dibromoethane)	8260C	0.20
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	8260C	0.50
Isopropylbenzene (Cumene)	8260C	0.20
m,p-Xylene	8260C	0.40
Methyl acetate	8260C	TBD
Methyl iodide (Iodomethane)	8260C	1.00
Methyl isobutyl ketone (4-Methyl-2-pentanone or (MIBK))	8260C	5.00
Methyl tert-butyl ether (MTBE)	8260C	0.50
n-Butylbenzene	8260C	0.20
n-Propylbenzene	8260C	0.20
o-Xylene	8260C	0.20
sec-Butylbenzene	8260C	0.20
Styrene	8260C	0.20
tert-Butylbenzene	8260C	0.20
Tetrachloroethene (PCE)	8260C	0.20
Toluene	8260C	0.20
Total xylene (reported, not calculated)	8260C	0.60
Total Xylene	Calculated	--
Trichloroethene (TCE)	8260C	0.20
Trichlorofluoromethane (Fluorotrichloromethane)	8260C	0.20
Vinyl acetate	8260C	0.20
Vinyl chloride	8260C	0.20
Pesticides (µg/L)		
2,4'-DDD (o,p'-DDD)	8081B	0.050
2,4'-DDE (o,p'-DDE)	8081B	0.050
2,4'-DDT (o,p'-DDT)	8081B	0.050
4,4'-DDD (p,p'-DDD)	8081B	0.050
4,4'-DDE (p,p'-DDE)	8081B	0.050
4,4'-DDT (p,p'-DDT)	8081B	0.050
Aldrin	8081B	0.025
Chlordane, alpha- (Chlordane, cis-)	8081B	0.025
Chlordane, beta- (Chlordane, trans-)	8081B	0.025
Dieldrin	8081B	0.050
Endosulfan sulfate	8081B	0.050
Endosulfan-alpha (I)	8081B	0.025
Endosulfan-beta (II)	8081B	0.050
Endrin	8081B	0.050
Endrin aldehyde	8081B	0.050
Endrin ketone	8081B	0.050

Table B-3
Surface Water Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	PQL ^a
Heptachlor	8081B	0.025
Heptachlor epoxide	8081B	0.050
Hexachlorocyclohexane, alpha (BHC)	8081B	0.025
Hexachlorocyclohexane, beta- (BHC)	8081B	0.025
Hexachlorocyclohexane, delta (BHC)	8081B	0.025
Hexachlorocyclohexane, gamma- (BHC) (Lindane)	8081B	0.025
Methoxychlor	8081B	0.250
Mirex	8081B	0.050
Oxychlorane	8081B	0.050
Nonachlor, cis-	8081B	0.050
Nonachlor, trans-	8081B	0.050
Toxaphene	8081B	1.25
Polychlorinated biphenyl Aroclors (µg/L)		
Aroclor 1016	8082A	0.01
Aroclor 1221	8082A	0.01
Aroclor 1232	8082A	0.01
Aroclor 1242	8082A	0.01
Aroclor 1248	8082A	0.01
Aroclor 1254	8082A	0.01
Aroclor 1260	8082A	0.01
Aroclor 1262	8082A	0.01
Aroclor 1268	8082A	0.01
Total PCB Aroclors	Calculated	--

Notes:

^a Reporting limits may vary based on sample size, target analyte concentrations, and matrix interference

µg/kg - micrograms per kilogram

µg/L - micrograms per liter

HPAH - high-molecular-weight polycyclic aromatic hydrocarbon

LPAH - low-molecular-weight polycyclic aromatic hydrocarbon

mg/L - milligrams per liter

PAH - polycyclic aromatic hydrocarbon

SIM - Selective Ion Monitoring

SM - Standard Method

TBD - ARI does not list this parameter for analysis. Either the PQL is not known or this parameter may not be

TSS - total suspended solids

WAD - weak acid dissociable

Table B-4
SPME Analyte List, Analytical Methods, and Reporting Limits

Analyte	Analytical Method	Target Reporting Limit ^a
PAHs (ng/L)		
1-Methylnaphthalene	1625M	TBD
Acenaphthene	1625M	TBD
Acenaphthylene	1625M	TBD
Anthracene	1625M	TBD
Benzo(a)anthracene	1625M	TBD
Benzo(a)pyrene	1625M	TBD
Benzo(e)pyrene	1625M	TBD
Benzo(b+j+k)fluoranthenes	1625M	TBD
Benzo(g,h,i)perylene	1625M	TBD
Chrysene	1625M	TBD
Dibenz(a,h)anthracene	1625M	TBD
Fluoranthene	1625M	TBD
Fluorene	1625M	TBD
Indeno(1,2,3-cd)pyrene	1625M	TBD
Naphthalene	1625M	TBD
Phenanthrene	1625M	TBD
Perylene	1625M	TBD
Pyrene	1625M	TBD
C1-Naphthalenes	1625M	TBD
C2-Naphthalenes	1625M	TBD
C3-Naphthalenes	1625M	TBD
C4-Naphthalenes	1625M	TBD
C1-Fluorenes	1625M	TBD
C2-Fluorenes	1625M	TBD
C3-Fluorenes	1625M	TBD
C1-Phenanthrenes/Anthracenes	1625M	TBD
C2-Phenanthrenes/Anthracenes	1625M	TBD
C3-Phenanthrenes/Anthracenes	1625M	TBD
C4-Phenanthrenes/Anthracenes	1625M	TBD
C1-Fluoranthenes/Pyrenes	1625M	TBD
C1-Benzanthracenes/Chrysenes	1625M	TBD
C2-Benzanthracenes/Chrysenes	1625M	TBD
C3-Benzanthracenes/Chrysenes	1625M	TBD
C4-Benzanthracenes/Chrysenes	1625M	TBD

Notes:

^a Reporting limits are 0.006 to 4 ng/L depending on hydrophobicity of the compounds.

ng/L - nanograms per liter

PAH - polycyclic aromatic hydrocarbon

SIM - Selective Ion Monitoring

SPME - solid phase micro extraction

TBD - to be determined

Table B-5
Marine Sampling Design Summary

Area	Sub-Area	Sample Type	Purposes	Number of Samples and Location Rationale	Sampling Location IDs	Primary Testing Parameters
Sediment Sampling						
Initial Study Area	Collocated Intertidal and Subtidal Sediment Grabs and Cores	Intertidal Grab Samples	To define the horizontal nature and extent of contamination in intertidal sediments	Bulk chemistry at five intertidal stations collected throughout beach area adjacent to former Gas Works and ravine	ISA-113 to ISA-117	Site COPCs ^a and alkylated PAHs
			Evaluate concentrations of Site COPCs along Gas Works intertidal area	Supplemental testing for bulk chemistry at five intertidal stations adjacent to former Gas Works and ravine		PAHs (including alkylated) in porewater
			Evaluate porewater concentrations of PAH and alkylated PAH concentrations	Porewater chemistry at five intertidal stations		
		Subtidal Grab Samples	To define the horizontal nature and extent of contamination in subtidal sediments	Twelve subtidal stations collected in transects down the slope toward to the channel elevation.	ISA-101 to ISA-112	Site COPCs ^a and alkylated PAHs
				Two subtidal stations collected in the westernmost transect and located within the marina	ISA-118 and ISA-119	
		Vibracores	To define the vertical nature and extent of contamination in intertidal and subtidal sediments in including NAPL and sheens	Five intertidal and fourteen subtidal stations Advanced in transects down the slope toward to the channel elevation and two within the marina	ISA-101 to ISA-119	Site COPCs ^a
	Other Intertidal and Subtidal Sediment Grabs	Intertidal Grab Samples	Provide bounding to the nature and extent of site-associated impacts in intertidal sediment	Two stations Step-out sampling in accessible intertidal areas within eastern extent of the ISA; the western intertidal extent is a riprap armored slope and not generally accessible	ISA-08 and ISA-14	Site COPCs ^a and alkylated PAHs
		Subtidal Grabs	To define the horizontal nature and extent of contamination in subtidal sediments	Fourteen stations Step-out sampling between slope area and ISA boundary	ISA-01 to ISA-07; ISA-09 to ISA-13	
Port Washington Narrows	Intertidal	Surface Grab	Document physical characteristics of intertidal sediments within Port Washington Narrows to inform sediment transport evaluations including littoral drift and bed load (to be evaluated with ADCP)	Eleven stations Collection of six along north side and five along the south side of the Port Washington Narrows stations placed in publicly accessible intertidal areas	PWN-01 to PWN-06; PWN-12 to PWN-16	TS, TOC, grain size, archive ^b
	Subtidal (Channel Bottom)			Five stations Collection along the general centerline and deeper sections of the channel	PWN-07 to PWN-11	
Surface Water Sampling						
Initial Study Area	Surface Water	Grab	Quantify concentrations of Site COPCs in surface water	Two locations Seasonal sampling at two depths per location	ISA-101 and ISA-106	Site COPCs ^c and alkylated PAHs
Port Washington Narrows		Grab	Quantify concentrations of Site COPCs in surface water to assess potential regional influences	Two locations Seasonal sampling at two depths per location	PWN-07 and PWN-11	
Habitat and Physical Surveys						
Initial Study Area and Port Washington Narrows	Subtidal	Towed-Camera Survey	Refine environmental setting information	Six transects perpendicular to and five transects in parallel with the Port Washington Narrows	--	Mapping of substrate, vegetation, aquatic species, and structures
	Subtidal	ADCP Transects	Measure near-bottom currents that may impact sediment stability	Four transects perpendicular to Port Washington Narrows (two tide conditions)	--	Conduct empirical measurements of near-bottom and mid-channel tidal currents for use in an analysis of sediment stability
Initial study area	Intertidal	Visual and Photo Survey	Conduct surveys of aquatic habitat and fish/shellfish resources near the Site	Seven locations within/adjacent to ISA intertidal area	PWN-14 and ISA-08; ISA-113 to ISA-117	Visual survey of shellfish resources

Notes:

a. Cyanide, WAD cyanide sulfide, grain size, hexavalent chromium, metals, organochlorine pesticides, PAHs, PCB Aroclors, SVOCs, TOC. Tiered analysis for PCB congeners, VOCs, and PCDD/PCDF will be contingent upon screening parameters (Sections 3.1.3 and 3.1.5).

b. Samples will be archived frozen for contingent analysis should additional testing be required.

c. Cyanide, WAD cyanide sulfide, DOC, grain size, hexavalent chromium, metals, organochlorine pesticides, PAHs, PCB Aroclors, SVOCs, TOC, TSS, VOCs.

ADCP - acoustic doppler current profiler

COPCs - chemicals of potential concern

D/F - dioxine/furan

ISA - initial study area

NAPL - non-aqueous phase liquid

PAH - polynuclear aromatic hydrocarbons

PCB - polychlorinated biphenyl

SVOC - semi-volatile organic compound

TBD - to be determined

TOC - total organic carbon

TS - total solids

WAD - weak acid dissociable

Table B-6
Station Identifications and Locations

Study Area	Sub-Area	Station ID	Easting ^a	Northing ^a	Sample Type				
					Surface Sediment Grab	Subsurface Sediment Core	Surface Water	Beach Shellfish Survey	Ex situ Porewater
Initial Study Area	Subtidal	ISA-01	1193322.170	217466.790	X	--	--	--	--
		ISA-02	1194184.215	216985.964	X	--	--	--	--
		ISA-03	1195383.762	216703.164	X	--	--	--	--
		ISA-04	1193168.980	217043.114	X	--	--	--	--
		ISA-05	1193635.017	216821.061	X	--	--	--	--
		ISA-06	1194011.201	216665.342	X	--	--	--	--
		ISA-07	1194609.467	216393.870	X	--	--	--	--
		ISA-09	1193367.549	216544.075	X	--	--	--	--
		ISA-10	1193633.548	216640.648	X	--	--	--	--
		ISA-11	1193829.236	216575.419	X	--	--	--	--
		ISA-12	1194060.503	216506.801	X	--	--	--	--
		ISA-13	1194292.617	216435.642	X	--	--	--	--
		ISA-101	1193688.784	216498.983	X	X ^b	X	--	--
		ISA-102	1193774.604	216482.840	X	X ^b	--	--	--
		ISA-103	1193854.303	216467.049	X	X ^b	--	--	--
		ISA-104	1193950.143	216428.205	X	X ^b	--	--	--
		ISA-105	1194048.715	216388.695	X	X ^b	--	--	--
		ISA-106	1194156.147	216343.606	X	X ^b	X	--	--
		ISA-107	1193663.181	216444.182	X	X	--	--	--
		ISA-108	1193760.353	216425.785	X	X	--	--	--
		ISA-109	1193831.527	216408.631	X	X	--	--	--
		ISA-110	1193928.000	216365.027	X	X	--	--	--
		ISA-111	1194023.669	216337.409	X	X	--	--	--
		ISA-118	1193524.268	216558.476	X	X ^b	--	--	--
		ISA-119	1193503.752	216482.808	X	X ^b	--	--	--
Port Washington Narrows Channel (Bed Load Sediment) ^d	Subtidal	ISA-08	1195204.924	216139.429	X	--	--	X	--
		ISA-14	1194545.854	216024.606	X	--	--	--	--
		ISA-112	1194142.000	216285.707	X	X ^b	--	--	--
		ISA-113	1193645.093	216371.871	X ^c	X	--	X	X
		ISA-114	1193807.793	216340.235	X ^c	X	--	X	X
Port Washington Narrows Littoral Drift (North and South Zones) ^{d,e}	Intertidal	ISA-115	1193912.655	216316.039	X ^c	X	--	X	X
		ISA-116	1193982.057	216218.338	X ^c	X	--	X	X
		ISA-117	1194123.229	216224.739	X ^c	X ^b	--	X	X
		PWN-07	1191969.706	218980.972	X	--	X	--	--
		PWN-08	1192545.457	218110.359	X	--	--	--	--
		PWN-09	1194332.242	217289.788	X	--	--	--	--
		PWN-10	1196114.321	216817.263	X	--	--	--	--
		PWN-11	1197576.165	216404.229	X	--	X	--	--
		PWN-01	1192765.408	219327.786	X	--	--	--	--
		PWN-02	1193252.359	218860.865	X	--	--	--	--
		PWN-03	1193612.319	218183.438	X	--	--	--	--
		PWN-04	1195532.976	217331.490	X	--	--	--	--
		PWN-05	1196242.871	217278.699	X	--	--	--	--
		PWN-06	1197704.179	216679.902	X	--	--	--	--
		PWN-12	1191581.488	218803.135	X	--	--	--	--
		PWN-13	1192293.066	217899.829	X	--	--	--	--
		PWN-14	1192908.400	216565.398	X	--	--	X	--
		PWN-15	1195937.771	216183.527	X	--	--	--	--
		PWN-16	1197304.483	215395.369	X	--	--	--	--

Notes:

^a Horizontal datum is Washington State Plane North, North American Datum 1983 U.S. Feet

^b Subsurface perimeter location. If NAPL is observed during core processing, an additional core will be advanced offset from this location to further delineate subsurface contamination. Additional core locations will be identified by FC and communicated to EPA.

^c Intertidal sediment location. Surface sediment grabs will be collected at low tide according to methods outlined in Section 3.2.5.

^d PWN sediment grabs will be analyzed for physical parameters only (grain size, total organic carbon, total solids). Extra sediment volume will be collected and archived.

^e Intertidal PWN sediment grabs may be collected either by hand (Section 3.2.5) or using a hydraulic Van Veen (Section 3.2.6) depending on access and tidal conditions.

EPA - U.S. Environmental Protection Agency

FC - field coordinator

ISA - initial study area

PWN - Port Washington Narrows

Table B-7
Guidelines for Sample Handling and Storage

Media	Analyte	Container ^a	Holding Time	Preservative
Sediment	Total solids and TOC	4-oz glass jar	14 days	Cool/4°C
			6 months	Freeze -18°C
	Total/WAD Cyanide	4-oz glass jar	14 days	Cool/4°C
	Sulfide	2-oz glass jar, no headspace	7 days	Cool/4°C; 1N ZnAc
	Grain size	16-oz glass or plastic jar	none	Cool/4°C
	Hexavalent chromium	4-oz glass jar	28 days	Cool/4°C
	Metals	4-oz glass jar	6 months; 28 days for Hg	Cool/4°C
			2 years	Freeze ^b /-18°C
	PAHs	8-oz glass jar	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C
	SVOCs/PCB Aroclors/Pesticides	16-oz glass jar	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze/-18°C
			40 days after extraction	Cool/4°C
	PCDD/PCDF and PCB Congeners	4-oz glass jar	1 year until extraction	Freeze -18°C
			1 year after extraction	Freeze -18°C
	VOCs	2-oz glass jar, no headspace	14 days	Cool/4°C
	Archive	8- or 16-oz glass jar	--	Freeze/-18°C
Water	Total cyanide	500 mL HDPE	14 days	Cool/4°C; NaOH to pH>12
	WAD cyanide	500 mL HDPE	14 days	Cool/4°C; NaOH to pH>12
	DOC ^c	250 mL Amber glass	28 days	Cool/4°C; H ₂ SO ₄ to pH<2
	Hexavalent chromium	250 mL Amber glass	1 day	Cool/4°C
	Metals	500 mL HDPE	180 days	Cool/4°C; H ₂ SO ₄ to pH<2
	PAHs	2 x 500 mL Amber glass	7 days to extraction	Cool/4°C
			40 days after extraction	Cool/4°C
	PCB Aroclors	2 x 1 L Amber glass	1 year to extraction	Cool/4°C
			40 days after extraction	Cool/4°C
	Pesticides	500 mL Amber glass	7 days to extraction	Cool/4°C
			40 days after extraction	Cool/4°C
	SVOCs	1 L Amber glass	7 days to extraction	Cool/4°C
			40 days after extraction	Cool/4°C
	TOC	250 mL Amber glass	28 days	Cool/4°C; H ₂ SO ₄ to pH<2
	TSS	1L HDPE	7 days	Cool/4°C
	VOCs	3 x 40 mL glass vial	14 days	Cool/4°C; HCL to pH<2

Notes:

^a Actual sampling containers may differ from this list as directed by the analytical laboratory

^b Mercury will be analyzed prior to freezing

^c DOC will be field-filtered

DOC - dissolved organic carbon

H₂SO₄ - sulfuric acid

HDPE - high density polyethylene

Hg - mercury

L - liter

mL - milliliter

NaOH - sodium hydroxide

oz - ounce

PAH - polycyclic aromatic hydrocarbon

PCB - polychlorinated biphenyl

PCDD/PCDF - polychlorinated dibenzo-p-dioxin/polychlorinated dibenzofuran

SVOC - semivolatile organic compound

TOC - total organic carbon

TSS - total suspended solids

VOC - volatile organic compound

WAD - weak acid dissociable

ZnAc - zinc acetate

Table B-8
Field and Laboratory Quality Assurance/Quality Control Sample Analysis Summary

Analysis Type	Field Duplicate	Field/Equipment Blank	Initial Calibration	Ongoing Calibration	Matrix Duplicates	Matrix Spikes	SRM or LCS	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
TSS/TS/Grain size	1 per 20 samples	NA	Each batch ^a	NA	1 per 20 samples	NA	NA	NA	NA	NA
TOC/DOC	1 per 20 samples	NA	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Total/WAD Cyanide	1 per 20 samples	1 per sampling event (total only)	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Metals	1 per 20 samples	1 per sampling event	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
PCB Aroclors/ Pesticides	1 per 20 samples	1 per sampling event	Daily or each batch	1 per 10 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
VOCs/PAHs/ SVOCs	1 per 20 samples	1 per sampling event	As needed ^b	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
PCDD/PCDF and PCB Congeners	1 per 20 samples	1 per sampling event	As needed ^b	Every 12 hours	NA	NA ^c	1 per 20 samples	NA ^c	1 per 20 samples	Every sample

Notes:

^a Calibration and certification of drying ovens and weighing scales are conducted bi-annually.

^b Initial calibrations are considered valid until the continuing calibration no longer meets method specifications. At that point, a new initial calibration is analyzed.

^c Labeled standards are added to each sample in isotope-dilution analyses, as required by the method.

DOC - dissolved organic carbon

LCS - laboratory control sample

NA - not applicable

PAHs - polycyclic aromatic hydrocarbons

PCB - polychlorinated biphenyl

PCDD/PCDF - polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans

SRM - standard reference material

SVOCs - semivolatile organic compounds

TOC - total organic carbon

TS - total solids

TSS - total suspended solids

VOC - volatile organic compound

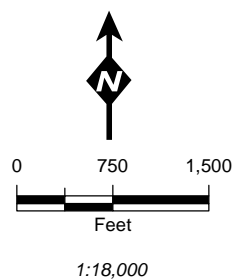
WAD - weak acid dissociable

FIGURES



NOTE:

If a paper copy is required, this figure is best printed in color.



Former Gas Works Location and Vicinity
Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington



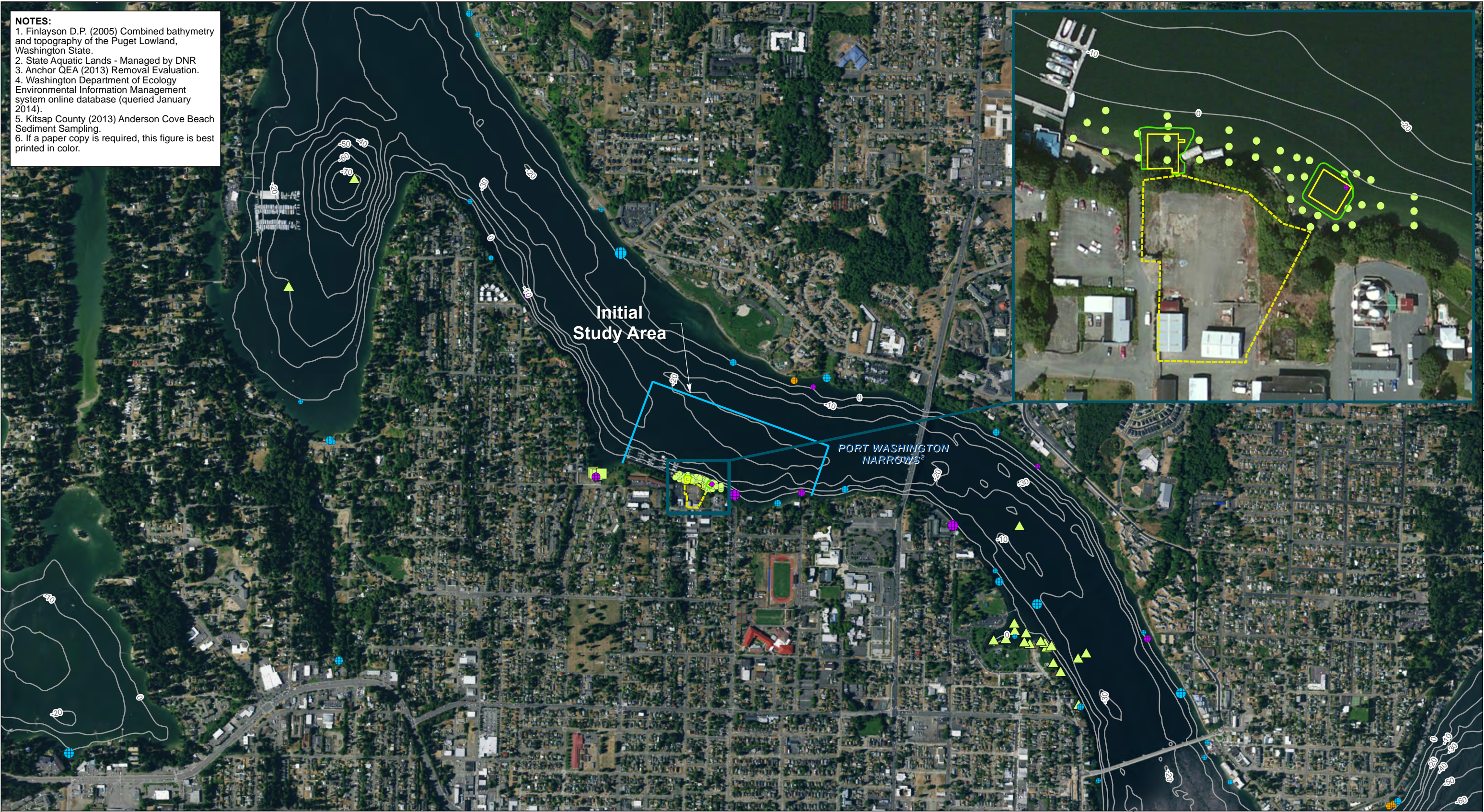
FIRM:
ANCHOR QEA

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ckiblinger

FIGURE NO.
B-1

NOTES:
1. Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. State Aquatic Lands - Managed by DNR
3. Anchor QEA (2013) Removal Evaluation.
4. Washington Department of Ecology Environmental Information Management system online database (queried January 2014).
5. Kitsap County (2013) Anderson Cove Beach Sediment Sampling.
6. If a paper copy is required, this figure is best printed in color.



Initial Study Area³

Former Gas Works Location

Cover of Existing Organoclay Mat (10-inch minus rock)²

Extent of Existing Organoclay Mat²

Surface Sediment Data Source

Anchor QEA³

EIM⁴

Kitsap County⁵

Outfall Size (inches)

8 - 12

13 - 24

25 - 36

37 - 48

49 - 60

61 - 72

73 - 84

Outfall Type

Combined Storm Drain/CSO Outfall

CSO Outfall

Storm Drain

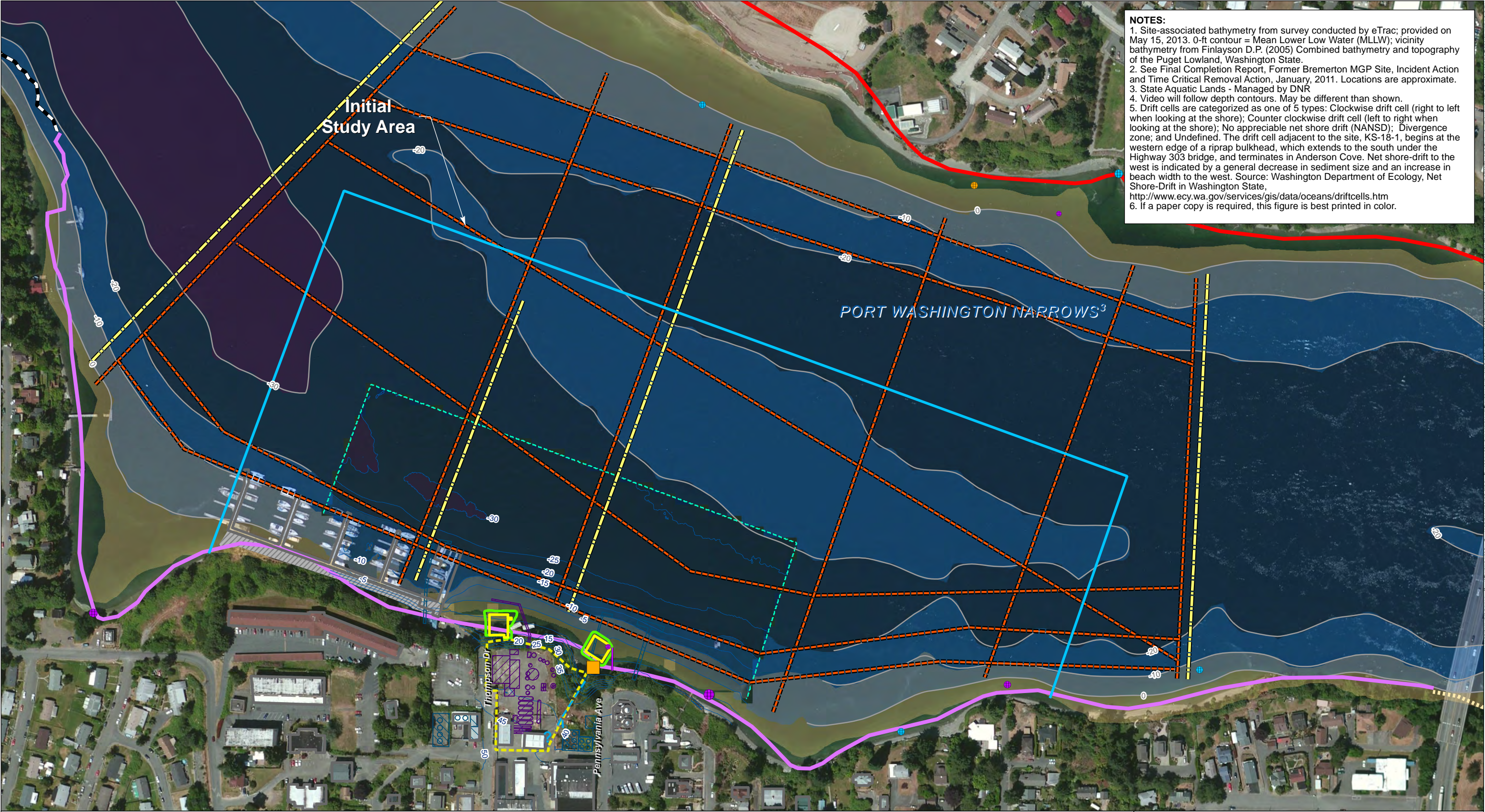
PSDEM 2005 10-foot Contours¹

Initial Study Area – Sediments
Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

FIRM:
ANCHOR QEA

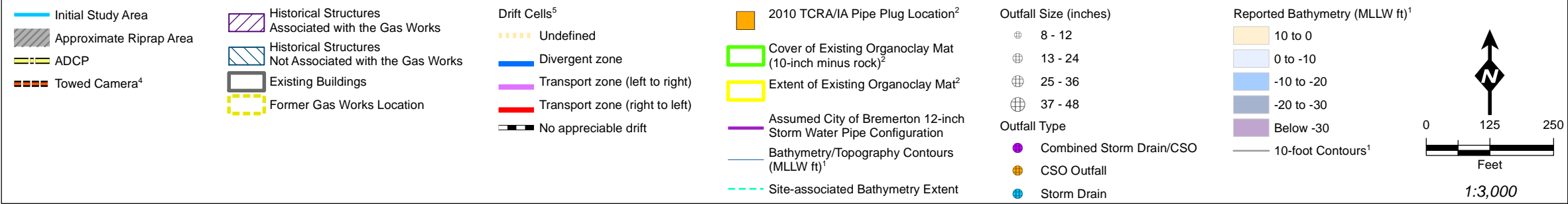
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FIGURE NO.
B-2



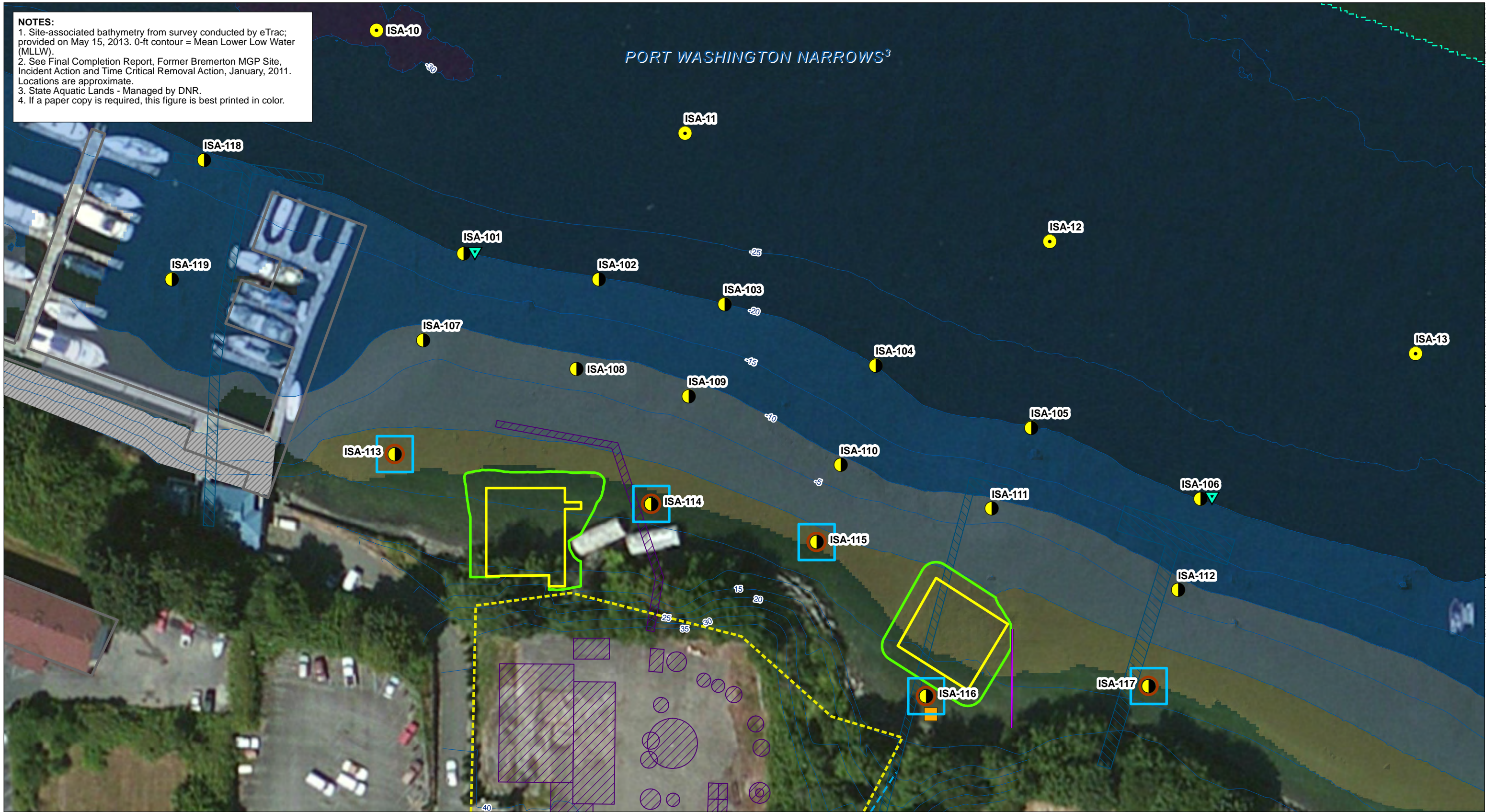
NOTES:

1. Site-associated bathymetry from survey conducted by eTrac; provided on May 15, 2013. 0-ft contour = Mean Lower Low Water (MLLW); vicinity bathymetry from Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. See Final Completion Report, Former Bremerton MGP Site, Incident Action and Time Critical Removal Action, January, 2011. Locations are approximate.
3. State Aquatic Lands - Managed by DNR
4. Video will follow depth contours. May be different than shown.
5. Drift cells are categorized as one of 5 types: Clockwise drift cell (right to left when looking at the shore); Counter clockwise drift cell (left to right when looking at the shore); No appreciable net shore drift (NANS); Divergence zone; and Undefined. The drift cell adjacent to the site, KS-18-1, begins at the western edge of a riprap bulkhead, which extends to the south under the Highway 303 bridge, and terminates in Anderson Cove. Net shore-drift to the west is indicated by a general decrease in sediment size and an increase in beach width to the west. Source: Washington Department of Ecology, Net Shore-Drift in Washington State, <http://www.ecy.wa.gov/services/gis/data/oceans/driftcells.htm>
6. If a paper copy is required, this figure is best printed in color.

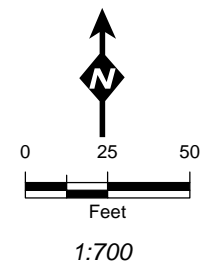


Video and Tidal Current Transect Locations
Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

NOTES:
1. Site-associated bathymetry from survey conducted by eTrac; provided on May 15, 2013. 0-ft contour = Mean Lower Low Water (MLLW).
2. See Final Completion Report, Former Bremerton MGP Site, Incident Action and Time Critical Removal Action, January, 2011. Locations are approximate.
3. State Aquatic Lands - Managed by DNR.
4. If a paper copy is required, this figure is best printed in color.



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|--|--|--|--|
| <ul style="list-style-type: none">Surface Sediment GrabSubsurface Core and Surface GrabSupplemental Analysis and ex situ Porewater TestingBeach Shellfish Survey LocationSurface Water Locations | <ul style="list-style-type: none">Historical Structures Associated with the Gas WorksHistorical Structures Not Associated with the Gas WorksExisting BuildingsFormer Gas Works Location | <ul style="list-style-type: none">2010 TCRA/IA Pipe Plug Location²Cover of Existing Organoclay Mat (10-inch minus rock)²Extent of Existing Organoclay Mat²Assumed City of Bremerton 12-inch Storm Water Pipe ConfigurationApproximate Riprap Area | <ul style="list-style-type: none">Bathymetry/Topography Contours (MLLW ft)¹Site-associated Bathymetry Extent |
|--|--|--|--|

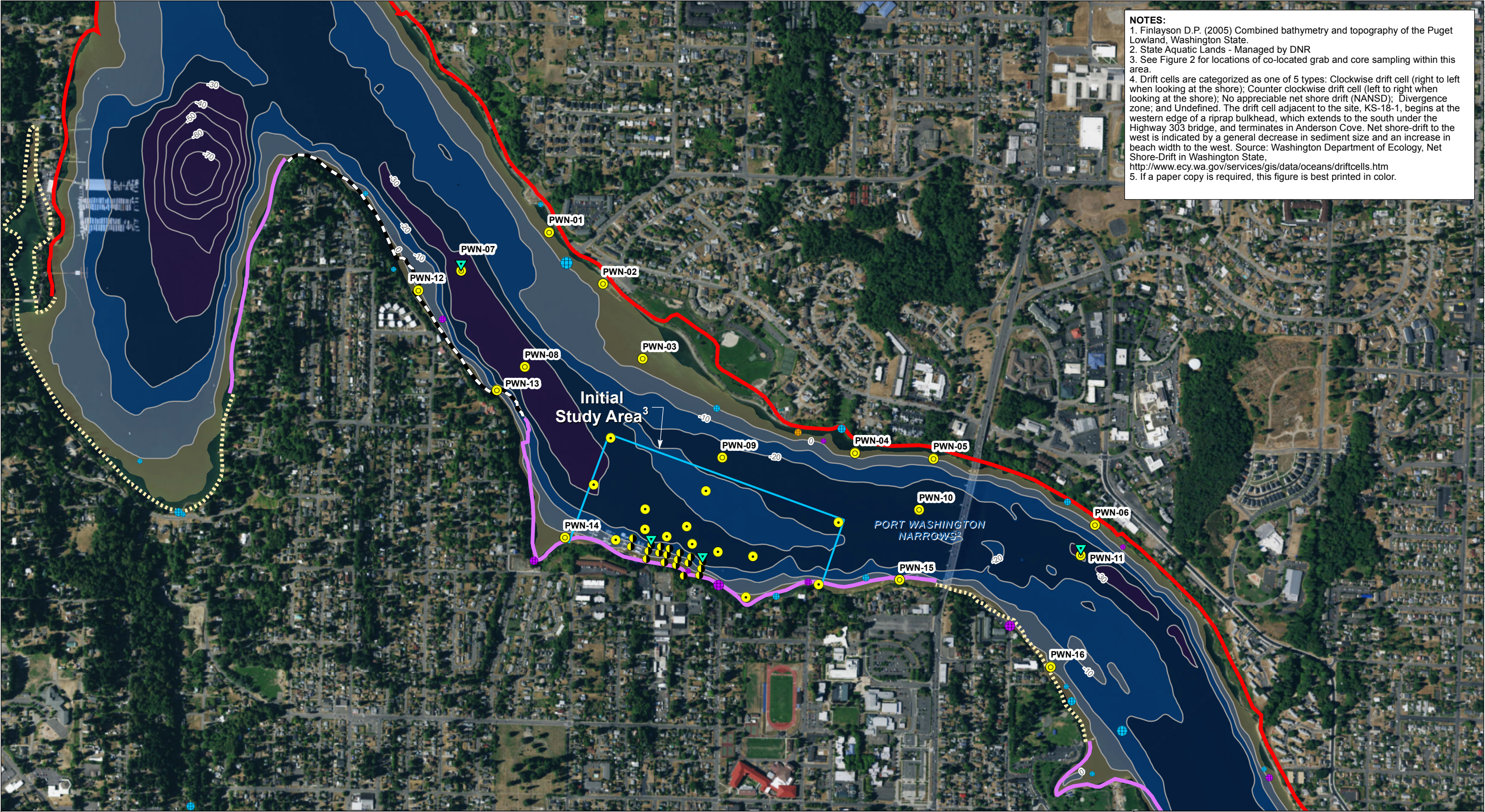


Initial Study Area
Grab and Subsurface Core Sampling Locations
Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

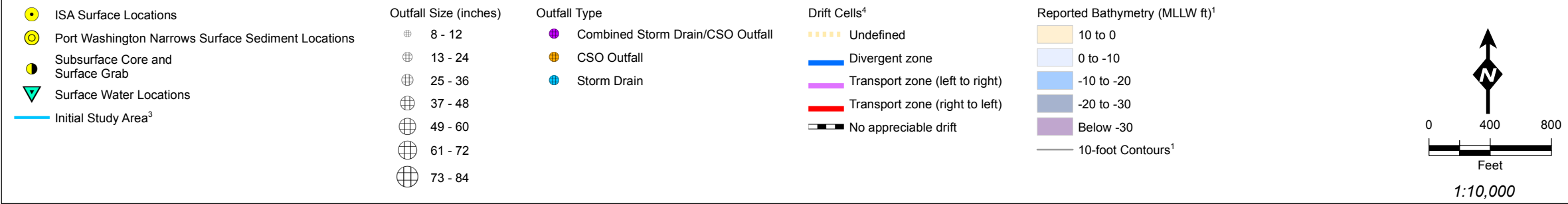


FIRM:
ANCHOR QEA
DRAWN BY:
ckiblinger

FIGURE NO.
B-4



NOTES:
1. Finlayson D.P. (2005) Combined bathymetry and topography of the Puget Lowland, Washington State.
2. State Aquatic Lands - Managed by DNR
3. See Figure 2 for locations of co-located grab and core sampling within this area.
4. Drift cells are categorized as one of 5 types: Clockwise drift cell (right to left when looking at the shore); Counter clockwise drift cell (left to right when looking at the shore); No appreciable net shore drift (NANSD); Divergence zone; and Undefined. The drift cell adjacent to the site, KS-18-1, begins at the western edge of a riprap bulkhead, which extends to the south under the Highway 303 bridge, and terminates in Anderson Cove. Net shore-drift to the west is indicated by a general decrease in sediment size and an increase in beach width to the west. Source: Washington Department of Ecology, Net Shore-Drift in Washington State, <http://www.ecy.wa.gov/services/gis/data/oceans/driftcells.htm>
5. If a paper copy is required, this figure is best printed in color.



Port Washington Narrows Sampling Locations
Marine Sampling and Quality Assurance Project Plan
Bremerton Gas Works Superfund Site
Bremerton, Washington

Appendix C

Historical Records

- 1942 Western Gas Company Investigation
- 1997 Svari Simonson Deposition Transcript
- Interview Notes – Clapp (1997), Simonsen (1997), and West (1998)
- 2014 Ralph Judd Interview Summary
- Undated drawing of Former Bremerton Gas Plant
- 1947 Sanborn Map
- 1968 Sanborn Map
- 1946 Aerial Photograph
- 1956 Aerial Photograph
- 1961 Aerial Photograph
- 1965 Aerial Photograph
- 1971 Aerial Photograph

**An Investigation
of The Western Gas Company of Washington
Bremerton, Washington**

**pertaining to
Fire-Hazard at the Gas Plant
Disposal of By-Products
Proposed Piping Ordinance**

by

**Gyben R. Tynstra
Registered Engineer
Associate Professor of Mechanical Engineering
University of Washington**

ML

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The Honorable H. A. Bruenn
 Mayor of the City of Bremerton
 Bremerton, Washington

Dear Sir:

Attached you will find the results of the investigation requested in your letter of March 14 pertaining to (1) fire-hazard at the local plant, (2) disposal of by-products, and (3) the proposed piping ordinance. Included in the report are suggested remedial measures for the conditions which were found to exist.

No attempt has been made to examine the gas plant proper to establish whether or not it will be able to supply the demand for gas if the city of Bremerton, its surrounding territory, and the Navy Yard continue to grow at the present rate. I shall be ready to make a further report at any time you express the wish for such additional investigation.

Respectfully submitted,

S. R. Tymstra
 S. R. Tymstra



25 Apr 42
 for Engineering Collection

AN INVESTIGATION OF THE WESTERN GAS COMPANY OF WASHINGTON

The Western Gas Company of Washington, located at Bremerton, Washington, was inspected on March 25 to establish whether or not it constituted a fire hazard and what disposal may be made of those by-products which cannot be sold. Moreover, the request made by the City Council to scrutinize the proposed ordinance for "The Installation, Maintenance, and Use of Piping and Fittings for City Gas" in customers' premises, was complied with.

The inspection trip to the gas plant was conducted by the Fire Chief, the Gas Plant Manager, and the writer.

INTRODUCTION

The plant itself is in a condition which can best be described as "better than average". About 700,000 cubic feet of carburated water-gas of 500 British thermal units heating value is made per day, and leaves the plant at a pressure of 40 pounds per square inch. This output seems to be close to the capacity of the plant. Any extensive growth of Bremerton, its surrounding territory, or the Navy Yard may, before long, demand increased gas-manufacturing capacity.

FIRE HAZARD

For the removal of tar from the gas, it is passed through apparatus filled with wood chips. In the past, excelsior was used for this purpose. While removing the tar from the gas, this material itself becomes covered with it and must finally be disposed of. Saturation occurs to a lesser extent with the iron-oxide-covered chips in other apparatus used for the removal of sulfur compounds from the gas.

The tar-laden wood chips and also the previously used tar-covered excelsior, as well as soot from the water-gas machines, is dumped at the edge of the plant near the oil-storage tanks in order to fill a gully. Tests conducted at the plant showed that (1) the soot will burn moderately, just about like fine coal; (2) the wood chips will burn somewhat better, just like kindling; and (3) the tar-soaked excelsior, when lighted, will flare up--as was to be expected. This condition, and particularly the proximity of the dump to the oil-storage tanks, constitutes a distinct fire hazard; especially so as no adequate fire protection is available in this section of the city.

DISPOSAL OF BY-PRODUCTS

The by-products of the gas plant consist of water-gas tar, a tar emulsion (combination of tar and water), and its effluent liquor, which is mostly water mixed with a little tar and oil.

The tar proper is sold to the Barrett Company and is shipped to Canada. The effluent liquor is lately being cooled to remove its condensable vapors and is sent to the bay through a drain pipe. The tar emulsion is dumped in shallow pits dug at random in the ground.

Tests conducted at the plant show that the emulsion carries so much water that it will not burn in its present state, not even when exposed to a bonfire. Therefore, it is decidedly not a fire hazard.

The pits or pools containing this emulsion are not guarded or fenced in, and therefore constitute a safety hazard for children playing around them and for others cutting across the vacant property on which these pits are located.

THE PIPING ORDINANCE

The proposed piping ordinance has been carefully examined. It is found to be an excellent one as a whole, but experience with it has pointed to some discrepancies, inaccuracies, and even some impossibilities.

RECOMMENDATIONS

FIRE HAZARD

a. A fire plug or hydrant should be installed in the street in front of the gas plant, and should be connected to the water main located there. This hydrant will also give fire protection to the houses across the street.

b. The tar-laden excelsior which is exposed to sight or easily accessible should be raked out of the dump, carried to a safe place, and burned.

c. The tar-covered wood chips, when dumped, should be evenly spread or raked out and be covered with a layer of the soot. This, in turn, should be covered with a layer of the ashes and cinders now dumped elsewhere. Care should be taken to have the ashes and cinders thoroughly quenched.

These suggestions will eliminate the fire hazard and change it to a safe dump.

Of course, the chips could also be burned if convenient, but this is not considered necessary if they are covered as suggested.

THE DISPOSAL OF BY-PRODUCTS

a. The disposal of effluent into the bay should be tolerated as long as it does not constitute too great a nuisance. Otherwise, it should be passed through a coke filter, which will absorb some of its objectionable constituents. The coke itself when saturated with these can be used up in the water-gas machines. However, the new cooler may have sufficiently cleared up this situation.

b. The emulsion could be used as road material, either after being treated, or as it is. In either case, the amount involved is too small to

warrant extensive preparations. Therefore, the gas company should be allowed to dispose of this at its own discretion, in either of two ways: (1) to cover the unpaved road to its own plant with a very thin layer, if the city will immediately cover it with sand; (2) to continue to dump it in shallow pits, but to put a simple and inexpensive fence around these, and ultimately to cover them with dirt. The fence will safeguard the pits sufficiently so as to remove all danger.

THE PIPING ORDINANCE

The following changes are recommended in the proposed piping ordinance:

Section

- 3-b Fourth line: change the word "never" to "not".
- 3-f Add "and an extension light complete with guard".
- 4-a Add "such craftsman shall also install the electric wiring between the standard electric system and any step-down transformer (similar to a doorbell transformer) furnishing a low voltage current for any gas-regulating device."
- 6-a b should come first and be called a; a should come second and be called b.
- 8 Do not add the words "30 lbs air pressure", inserted in red in the code. Section 4 of the appendix covers the details of testing.
- 11 Reference is made in a and b to "a gas fitter not in the employ of the gas company". In a and d reference is made to "a gas fitter", but "a gas fitter not in the employ of the gas company" is meant.
- 12-c Fourth line: delete "or into the combustion...burning flame".
- 14-a Ninth line: change the word "best" to "standard".
- 14-d Fourth line: change the word "perfect" to "good"; delete "in that building".
- 14-e Change "all bends" to "all sharp bends".

17 Change to read: "Piping to be Sloped.

All piping shall be sloped, preferably not less than $\frac{1}{2}$ inch in 15 feet to prevent traps. The entire piping system should drain back towards the meter, unless the structure is so framed as to prevent this; but this rule does not permit violation of Rule 16. In the latter case, proper means must be provided to take care of the condensate."

Whether or not the appendix is intended to be part of the ordinance is problematical. If it is to be included, then exception is taken to section 9. This section is called "Inspection of New Piping", but it concerns itself greatly with the testing of the piping by the proper administrative authority. No one is more interested in a tight piping system than the gas company, and it should do the testing without further supervision. Otherwise, the testing equipment will have to remain connected until a city inspector gets on the job. Past experience with a similar code has shown that this may take days. In the meantime the customer is deprived of the use of gas, and the gas company's testing apparatus is tied up or must be reinstalled.

VIDEO DEPOSITION OF SVARI SIMONSON
(Written transcript of videotape/audiotape)
November 24, 1997

Participants: Tom Lindley, Miller Nash ("TL")
Svari Simonson, Former Employee of Cascade ("SS")

[Note: ** = indicates word or phrase within asterisks is unclear]
[** = totally indecipherable word or phrase]**

TL: Good afternoon, this is Tom Lindley. I'm an attorney with Miller Nash. Miller Nash is legal counsel for Cascade Natural Gas. It is Monday, November 24, 1997; a few minutes before 1:00 in the afternoon. I'm here to obtain some information relating to the Bremerton, Washington manufactured gas plant site. This matter came to the attention of Cascade Natural Gas and to my attention based on a letter from William Sesko -- S-E-S-K-O -- that was sent by Mr. Sesko's attorney to Cascade Natural Gas talking about the old Bremerton gas works, and I have marked that -- just for purposes of the record to go along with the video -- as Simonson Video Exhibit No. 1. I'm not going to go through it and we aren't going to use it, but the purpose of referring to Simonson Video Exhibit No. 1 is to point out that it is a demand from Mr. Sesko through his attorney to Cascade and that it attaches to it as its third page, a map that the letter describes as a 1928 Sanborn map. Now, this 1928 Sanborn map is one that I'm going to be using throughout this talk to try to gain additional information about what happened at this facility. We invited Mr. Sesko or his attorney to be present today, as we were attempting to get more information. We've received an indication that they have chosen not to attend. We again offered them another opportunity and they have not responded.

We're here today with a former employee of Cascade Natural Gas, and that is Mr. Simonson, and I'm going to ask Mr. Simonson to identify himself for the camera and for me.

SS: Oh, I'm Svari Simonson.

TL: And Mr. Simonson, when were you born?

SS: (b) (6)

TL: And where were you born?

SS: (b) (6)

TL: (b) (6)

SS:

TL: (b) (6)

SS: (b) (6)

TL: After leaving (b) (6) did you join with a gas company?

SS: Yes.

TL: And what was that gas company?

SS: Western Gas; located on Thompson Drive.

TL: And that's Thompson Drive in Bremerton, Washington?

SS: Right.

TL: And about what year was that?

SS: 1953.

TL: And did that -- what was at that plant or that site?

SS: It was a manufacturing gas plant; manufacturing gas for public use.

TL: And how long did you stay at that plant site? How long did you keep working at that plant site?

SS: You mean before we got the propane ****air**** in?

TL: At least initially, yes.

SS: Around roughly two years.

TL: Okay; were you at the sight until it ultimately closed?

SS: Yes.

TL: Did the site ever transfer from Western Gas to another gas company?

SS: Yeah; transferred to Cascade Natural Gas.

TL: Did you continue to work with Cascade Natural Gas?

SS: Yes, I did.

TL: But not at that plant site.

SS: No.

TL: After it was converted to propane.

SS: Yeah; then we worked out of the office -- downtown Bremerton.

TL: Okay; we'll talk about that plant site in some -- at some length in a moment or so. What positions did you hold at the Bremerton manufactured gas plant site?

SS: At the time there was shut down?

TL: What did you start as?

SS: I started as a gas maker's helper.

TL: Um-hmm.

SS: And ended up as a gas maker.

TL: Okay; and what does a gas maker's helper do?

SS: You keep the place up -- clean, neat -- and you also haul in briquettes to be used in the generator to generate the heat to what we call crack down the oil to make gas out of the oil.

TL: And what did the gas ma -- what did you do as the gas maker at that facility?

SS: Then I was making the gas.

TL: Okay; let's talk a moment about how you manufacture gas. Many people these days are accustomed to turning a switch.

SS: Um-hmm.

TL: And the heater comes on and the gas comes through pipes.

SS: Um-hmm.

TL: We're talking now about something you were doing in the early 1950's. How did you make gas?

SS: Well, first we had a generator that was heated up to -- I'm not sure -- say 11 -- 1200 degrees and then the oil come in -- into that hot wall and evaporated. Then it went from there into a scrubber where the gas goes through a tank where you have wooden slots and ****water**** so the gas is kind of washed out. Then it goes from there and into holder and from the holder it goes into a purification and from there it goes into the holder that supplies the gas for the city. Is that about --?

TL: That's a good summary. In terms of the way you heated it, I believe you used the word "briquettes".

SS: Yes.

TL: Were they a fuel for a heater of some sort?

SS: Right; they were used in the generator for heat.

TL: And you said that oil would go in and be evaporated.

SS: Right.

TL: What type of oil was that?

SS: Diesel oil.

TL: And the diesel oil would then go through -- if I understood correctly -- you said after it evaporated it would go through some sort of scrubber?

SS: Yes.

TL: And can you tell me a little more about the scrubber?

SS: The scrubber is a tank with wooden boards and water sprinkling over the wooden slots and the gas goes through there and that's what the scrubber did before it went into the purification.

TL: And what happened in the purification section?

SS: Well, that takes all the impurities out of the gas and takes some of the odor out of it and that's about only thing it is.

TL: And then the gas would go into storage tanks?

SS: Yes.

TL: And from the storage tanks it'd be pumped to the people who were going to use the gas.

SS: Yeah, the -- we had the -- we had two compressors that was pumping into the storage tanks and they were kept up to -- oh, I can't remember for sure, but around 80-85 pound of pressure on those storage tanks. So when we shut the plant down in the evening, then the city had plenty of gas coming out of the storage, so they were drawing out of the storage tanks at all times.

TL: So you made gas only part of the day, but you'd store what you made and then that stored portion would be used in the evenings?

SS: Yes and through the day also.

TL: With -- you mentioned that at some point the plant was closed down as a manufacturing plant; is that correct?

SS: Yes, yes.

TL: And that was approximately 1955 or '56?

SS: Yeah, around that time; yes.

TL: Can you describe what happened when that plant was closed down as a manufacturing plant?

SS: Well, everything -- the machines were shut down and the only thing we used as a compressor, we had automatic -- installed automatic propane air plant and the compressor then pumped the gas into the old storage tank that was previously used for manufactured gas; so used the same tanks.

TL: So you didn't need the briquettes anymore.

SS: No.

TL: And you didn't need the diesel oil anymore.

SS: Right.

TL: Let's talk about -- now we've talked about the gas and how it was made.

SS: Um-hmm.

TL: And where it went, when you make gas and you evaporate oil you get some sort of by-products don't you? Or waste?

SS: Right; we had bug juice -- and there was very little of it and then we had creosote. And the creosote was hauled out to -- on the barge from the dock we had. We pumped the creosote down to the dock and they hauled it out of there on barges.

TL: Now some people might call creosote a waste since it's generated as a byproduct of the process.

SS: It's a byproduct that's a good selling product that people in **** bought it. They use it to all kinds of things. They can even use it to paint with it so iron won't rust. What they did over in Seattle or wherever they got the big tanks. I don't know.

TL: But it was a valuable byproduct that you were able to sell.

SS: Oh, yes.

TL: And you said you loaded it off the site by the -- to a barge?

SS: Yes.

TL: You also mentioned bug juice.

SS: Um-hmm.

TL: Can you tell us a little bit about that?

SS: Well, there isn't much I can tell you about that because we didn't have much of it, but we had used a sprinkling can and sprayed on the weeds and the blackberry -- those going along the fence next to the road out there on Thompson Drive. So we kept that neat and clean looking.

TL: Did you spray the bug juice anywhere else?

SS: No.

TL: Did you ever dump it anywhere or ever hear of it being dumped?

SS: No; nuh-huh.

TL: Did you or did any of your colleagues use the bug juice for anything?

SS: Well, they told me they had even used it in their cars during the war.

TL: To go with their gasoline?

SS: Yeah; and they said -- one fellow was telling me that stuff is so hot even burned the valves on his engine, so they could prove that it worked all right.

TL: So this particular byproduct that you're calling bug juice --

SS: Um-hmm.

TL: -- was very flammable?

SS: Yes, yes.

TL: And did you ever use it in your car?

SS: No.

TL: Okay; you've described the property in Bremerton and said it was near Thompson. I'm going to pull up a map of the area and we'll ask you to talk for just a little bit about the map. This is an enlargement of the map that I just showed from Mr. Sesko's attorney's letter, and it's the same map; just a larger size. Let's see if I can fold it flat here and hold it out. And then I'm going to ask you some things about the map.

SS: Um-hmm.

TL: Now, there's a reference -- this is a 19 -- is designated as a 1928 map. You indicated you started working there in the 1950's.

SS: Um-hmm.

TL: 1950 --

SS: Three.

TL: -- three; is this Western Gas Company site located where the Western Gas Company site was that you worked at?

SS: Right; correct.

TL: That's between roughly -- somewhere between Pennsylvania Avenue and Thompson Avenue?

SS: That's correct.

TL: And it shows the Port of Washington Narrows -- or Port Washington Narrows.

SS: Um-hmm.

TL: That's a waterway adjacent to that; isn't it?

SS: Yes.

TL: Now, was the lan -- was the land itself hilly or generally flat or how was it in that area?

SS: Where the plant was located it was pretty flat in there.

TL: Okay.

SS: Right in --

TL: And what was the bank going to the water like?

SS: It was very steep. Nobody could even walk down that.

TL: Okay.

SS: It was really steep. They had some -- in fact, they had build steps to go down to the dock ****bay**** because nobody could walk it.

TL: And you've mentioned the dock; I'll ask you: did Western Gas or Cascade Gas have a dock at this site?

SS: Yes, we had one down below here.

TL: And that dock would be sort of off the area that on this map is labeled "winch" and be about this part of the property?

SS: Yes; it be close to that; yes.

TL: We'll have a larger version of this whole area in a moment, but what I'd like to do is to talk about the rest of the area now with some of the neighbors on the map.

SS: Um-hmm.

TL: This map shows a Richfield Oil Company to be -- north is at this side of the map. Do you see that? Is this your recollection as well?

SS: North -- the be --

TL: So that north --

SS: North -- yeah; so the be west of Thompson Drive; right?

TL: I'll have to -- I have to ask you that but --

SS: Yeah.

TL: Did Thompson Drive run north/south?

SS: Yes.

TL: Okay.

SS: So then this would be west and here was a hill from Thompson Drive and north there was a hill going over there.

TL: And Richfield Oil Company was up that hill?

SS: Up on the hill; yes.

TL: And it -- it was Richfield Oil then. Thompson Drive runs north/south.

SS: Um-hmm.

TL: Richfield Oil Company would be to the west and Richfield was up a slight or a steep hill?

SS: Oh, a slight hill.

TL: Slight hill.

SS: Yeah.

TL: Okay; and that was still operating when you were there in the 1950's.

SS: Right.

TL: Okay. Now, just south of the Western Gas Company site is an area identified as "lent's" -- L-E-N-T'S.

SS: Yes.

TL: Do you remember the Lent's was there when you were there in the 1950's?

SS: Yeah; they had that property at that time; yeah.

TL: Now, immediately to the east of the Western Gas Company site is what appears to be a drawing of a number of gasoline or diesel or fuel tanks of some sort. Do you remember whether those tanks were there in the 1950's?

SS: Yes, they were there.

TL: Do you remember who owned them at that time?

SS: It was Lent's because I see Lent's had the big trucks out there.

TL: Okay; and for -- just to make this -- this is north on this map; this is south on the map. Thompson runs north to south and Lent's would be then immediately south of your plant site.

SS: Yes.

TL: And these are the tanks that you were talking about?

SS: That's correct; yeah.

TL: Now, the map has a big open area to the north of Richfield Oil. Do you remember anything being located there?

SS: Yeah, they have a yacht club down there. Let's see; the yacht club will be right down in this area.

TL: So it would be just immediately north of the Richfield Oil Company and immediately west of Thompson Avenue?

SS: Yeah, that's correct.

TL: Okay. Now, when you say a yacht club, is that a marina of some sort?

SS: Yeah, they had that marina there and they also -- I met some people lived on their boat down there, so --

TL: When was that?

SS: Was in 1954?

TL: Okay; if I may, what I'd like to do now is turn to the blow up or the enlargement of the Western Gas Company site portion of this map and to talk with you about that portion of the site.

SS: Okay.

TL: I'm gonna make one exception; my apologies.

SS: Okay.

TL: We've talked about there being -- let's see if I can hold this up -- fuel tanks in this area. Do you remember any fuel tanks over to the east of Pennsylvania Avenue?

SS: Yes; ***** had big tanks up there.

TL: And you mentioned the dock --

SS: Um-hmm.

TL: -- for Western Gas which was just off this area of Western Gas.

SS: Yes.

TL: Was there another dock?

SS: Yeah; Lent's -- Lent's had a dock further up this way.

TL: And is that dock still there?

SS: That I don't know.

TL: Okay.

SS: I haven't been around that way ***** couldn't tell you.

TL: Okay. Do you know whether any of the other companies in this area also used that dock?

SS: No.

TL: Okay; did Cascade or Western ever use this other dock?

SS: No.

TL: Did anyone other than Cascade or Western ever use the Cascade dock?

SS: No.

TL: Okay. Now, I'm going to hold up and then I'll put down so we can talk about it --

SS: Okay.

TL: -- the enlargement of the portion of the map that was the Western Gas Company site.

SS: Um-hmm.

TL: And this is again from that 1928 map and this is simply labeled "Simonson Video Exhibit No. 3", so it's the same map we've been about. But do you recognize this general area?

SS: Yes.

TL: And is this the area we've been talking about?

SS: Yes.

TL: Now, I'll -- the dock I believe you said would be just off of the Lent's area?

SS: That's correct; yeah.

TL: What was the dock used for again?

SS: We loaded creosote on barge down there. They -- I don't know who bought the creosote, but they come in with the barge with a big tank and we loaded the creosote down there.

TL: And did you bring things from the dock onto to the site?

SS: Yeah; we also got propane delivered. They we pumped that up to a propane tank over in here.

TL: And where did your briquettes come from?

SS: I don't know where they came from, but we got a couple of loads in on the barge and later they was hauled in with trucks.

TL: Where were the briquettes stored?

SS: They were stored right in the area behind, well, they'll be west of the building -- in the back of the building in there. That's where they stored all the briquettes.

TL: And that on this map would then be the area immediately east of Thompson Avenue?

SS: Yes.

TL: So the briquettes then would be stored right in here?

SS: Right.

TL: Okay; and you said the creosote would be pumped from a tank up in here somewhere.

SS: Um-hmm.

TL: Down to the dock?

SS: Right.

TL: And propane was pumped up to a propane tank here.

SS: Right.

TL: Okay; now, just in terms of direction -- again this is an expansion of the earlier maps, so north goes this way and that would mean that this is the same Richfield Oil site.

SS: Yes.

TL: Okay; and we talked about a fence.

SS: Um-hmm.

TL: You mentioned the fence where some bug juice was sprayed.

SS: Yes.

TL: Where was that fence on this map? Can you point it out?

SS: The fence was going -- let's see -- going from the gate and over here a little ways.

TL: Okay; was there also a fence between yourself and Lent's?

SS: Yes.

TL: Okay; was there any other fence going back this way?

SS: No.

TL: Now, this again is designated a 1928 -- can you tell me what part of this was there when you were there in the -- from 1953 to 1956?

SS: Well, this stuff in the storage tanks and everything was there. I don't recall ever seeing those tanks up there.

TL: So these what are listed as oil and gasoline tanks were not there when you came in the 1950's?

SS: No; I never seen them.

TL: And these diesel tanks -- were they there or were they gone by then?

SS: We had only one diesel tank and it was a square tank.

TL: Okay; that was -- I believe you pointed here?

SS: Right.

TL: Okay; now, this shows the big circle that it calls a gas holder.

SS: Right.

TL: Can you describe what that was?

SS: Well, when they made the gas they came out of the gas machines through the scrubber and into this -- this tank. They was floating **** by water, so when the gas got in there it just lifted this top of the tank up -- just floating in the water.

TL: So that was where the gas went when it was first coming out of being manufactured.

SS: That's right.

TL: Where did the -- and then you mentioned the gas went to scrubbers.

SS: Yes.

TL: Or to a scrubber; where was that scrubber?

SS: The scrubber's located right next to that storage tank.

TL: So it's this little circle right here?

SS: Yes.

TL: Okay; now these are -- these three circles are called scrubbers here, but I believe you've used another word to describe those?

SS: Yeah; they was the ****putifiers**** **[purifiers?]**. We took some of the odor out of the gas and other impurities that was in the gas that was taken out by using this wooden chips and some oxide of some -- some kind. I don't know exactly what that was.

TL: So the gas would be purified in these purifiers and then would be pumped into the storage tanks?

SS: That -- yeah, that's correct.

TL: Now, that would mean that there was some sort of waste coming out of the purifiers?

SS: Yes; they was -- they were cleaned out every so often, but I never saw where the waste went, but it could've been hauled out and I wasn't at work that day or whatever.

TL: So the wood chips and so on that you've described were hauled -- they were not stored on site?

SS: No; they're hauled out.

TL: Okay; now, this 1928 drawing shows six roughly equal -- or equal tanks.

SS: Um-hmm.

TL: When you were there in the 1950's were all the tanks the same size?

SS: No; the one on the very end over here was a little smaller than the others.

TL: And what did it hold?

SS: It held creosote.

TL: Now, this is designated BLR RM. Can you tell me what this was? What this part of this building was?

SS: That's where the machines were. We had two machines, one in the north end and one in the middle of the building where we made the gas. So we had two machines and one was shut down, then we overhauled the other ***** ready.

TL: Did you ever use a boiler to heat those machines?

SS: It was a generator we called it; a generator. That's where we used the briquettes to keep the temperature up.

TL: Okay.

SS: So --

TL: Now, was this -- were those machines on the ground or were they on concrete or were they on -- how -- describe the building to me if you will.

SS: Well, there's a big building and a concrete floor.

TL: And there would be a pipeline that connected that building to the -- to the gas holder?

SS: Yeah; there had to be.

TL: And what is this small building over here?

SS: That -- that is the same. That's no building there. The building goes straight over and there's no building there. What we had in there was a little shed with a 50-horse electric motor that was run the cable down to pick up the briquettes on the -- run the bucket on the cables picking up the briquettes down in the bay.

TL: There's a dotted line sort of rectangle up here. Do you know, was there something there when you came in the 1950's?

SS: No, was nothing there.

TL: Okay; now, you've indicated that the briquettes were stored here.

SS: Yes.

TL: There's also some space up here. What was this used for?

SS: Well, when I came they had the propane -- big propane truck delivered and they sold propane around town, and that truck was parked in there. There was no building there.

TL: Did anyone ever park anything else in there?

SS: Yeah, we had the fellow that bought the bus that went between Poulsbo and Bremerton and he bought that bus and made it into motor home, and he had that parked there.

TL: Now, can you describe what this area was like? Was it --

SS: Well, it was more like a gravel parking lot. That's what I would call it; and then in the back there's a steep bank that goes down and had some -- I guess that belonged to Lent's -- and there were just tiny little trees growing in there and that kind of stuff; bushes, whatever.

TL: Now, when this facility -- when this plant was converted from a manufacturing plant to a propane plant, how many tanks or what type of tanks were used to store the propane?

SS: One tank.

TL: And do you know what happened to the other tanks?

SS: Well, excuse me, the other tanks were used for storing manufactured tanks -- manufactured gas and they were then used to store the propane air we had for the city.

TL: Now, with all the gas being manufactured on site or brought on side, presumably you had some way to get it off site. You had a gas pipeline of some sort?

SS: Well, we had the distribution system in Bremerton.

TL: Can you point out where that gas line would've come out from this -- on this drawing?

SS: Yeah, it came -- came out from here, going straight down and up to Thompson.

TL: So it would come in essence from east to west onto Thompson?

SS: Um-hmm.

TL: And then it would go south on Thompson.

SS: Right.

TL: And do you know about how far down Thompson it went?

SS: Well, it went to 15th Street and then went east on 15th Street and over on High Street. It went -- it went down High Street to 13th Street and that's where you had the regulator station. That's -- for that line then went into the distribution system.

TL: Who were the biggest customers at that time?

SS: Navy Yard.

TL: Did anyone other than the Navy Yard use Cascade or Washington -- or I'm sorry -- Western Gas?

SS: Oh yes; we had quite a few. We had 500 customers -- 400 -- 500 customers.

TL: Good; and can you name some of those other customers? For example, was the city a customer?

SS: No; they're mostly private homes. We had gas downtown but I -- I couldn't -- I couldn't name them; mostly private homes.

TL: Okay.

SS: In any place -- any street, so I couldn't tell you.

TL: Now, was this pipeline that went first over to Thompson then up Thompson and underground or above ground pipe?

SS: That was in the ground.

TL: Within the ground?

SS: Yeah; in the ground.

TL: Okay; you were at this site from 1953 until it closed?

SS: Yes.

TL: And would you tell me -- can I offer you some water?

SS: Thank you.

TL: Can you tell me how the site was maintained or kept up?

SS: We always took real good care of it. In fact, we were so particular about this -- I should have told you sooner. We had briquettes that broke and turn to powder ****. We would clean that up and we had a little machine here. We used to take the stuff it cleaned up and heat it with steam and make new briquettes out of it. Everything was kept just -- just great.

TL: Were the grounds kept the same way?

SS: Yes.

TL: At -- in some manufactured gas plant sites there's talk of tar or tar pits or tar wells. Did you have any tar wells or pits or piles on site?

SS: No, we never had anything like that.

TL: Did you ever have any big spills or releases that you were -- either while you were there or that you heard of from before you were there?

SS: No, we never did; nuh-huh.

TL: Now, you mentioned changing the purifiers for example. Did you ever have any problems when you were changing the purifiers?

SS: No; I don't see what kind of problem that could be.

TL: There wasn't, for example, a big spill or a big pile of the purifier wood chips?

SS: No, nuh-huh, no; that was taken care of.

TL: We talked about the site being closed. When you refer to the site being closed, can you tell us again what you mean by that?

SS: Well, it -- I don't quite understand what you mean "the site being closed".

TL: It converted from a manufactured gas plant to a propane site.

SS: Yes.

TL: Did you -- when you said you worked there 'till it closed.

SS: Yeah.

TL: Were you involved with the transition to propane?

SS: Yes. We would use the same storage tanks and the same building when we made the propane gas.

TL: Did you continue to work at the site after it became a propane site?

SS: Yes.

TL: How much longer?

SS: Until we got natural gas in town. I can't remember what year that was. Couple of years I believe.

TL: And after you left this plant site, after you got natural gas in town, what happened to this site?

SS: I really don't know because I got too busy working downtown, so I never even went back up there to -- to look. Well, I went by up there but nothing was going on at the time.

TL: So if I understand correctly, after natural gas was brought in to Bremerton, you moved to the Cascade offices; is that correct?

SS: That's correct.

TL: And what did you do for Cascade after you left this plant site?

SS: I was a service mechanic.

TL: And you didn't have to go back to this plant site to service anything?

SS: Not after we got natural gas; no.

TL: Okay.

SS: I went by up there just when I happened to be in the neighborhood, but nothing was going on, and then I just didn't go back again before, well, everything was torn down and gone next time I saw it.

TL: Were you ever involved in any part of the sale of any part of this property or the tearing down of any part of this property?

SS: No.

TL: I'd like to talk with you about other people who worked at the site. Do you remember, for example, who the supervisor at the site was?

SS: Yeah; his name was Dick Rutz.

TL: Can you spell his last name?

SS: (b) (6)

TL:

SS:

TL: Now, you said "he". Is this (b) (6) ick?

SS: That's (b) (6)

TL: Is Dick still alive?

SS: No; he's gone.

TL: (b) (6)

SS:

TL: But Pat -- did Pat also work at the site?

SS: Yes.

TL: Do you remember the names of any others who worked at the site that might still be alive and able to tell us about it?

SS: No, I really don't. The only thing I can remember is a fellow by the name of Pete and I heard that he at one time was working for Washington Natural Gas and I believe he was in Oregon. So, I'm -- I'm -- that's the only one I can think of would be alive.

TL: Okay.

SS: I know the name of the other people if you need them.

TL: But are any of the -- are any of them alive *****?

SS: Not that I know of; no.

TL: Okay; if I may, I'm going to take a deep breath and ask you to take one and I'm going to check my notes and we'll see if there's anything else I need you to ask you.

SS: Okay.

TL: Mr. Simonson, I'll -- we've both talked and neither of us can remember anything more to ask. Is that -- at least I can't remember anything more to ask. Do you have anything more you want to say about it?

SS: No, I really don't.

TL: Okay.

SS: I -- that's all I can remember from the good old days.

TL: The attorney for Mr. Sesko and Mr. Sesko have not appeared, so I believe we are done. Thank you very much.

SS: Okay; my pleasure.

Videographer: So go off the video record; the time is 1:37 p.m.

BREMERTON GAS WORKS SITE HISTORICAL INFORMATION

John West Notes Regarding Conversation With Melvin C. Clapp

- John West is a former attorney for Cascade Natural Gas Corporation. Mr. West discussed the former manufactured gas plant (MGP) with Mr. Clapp and prepared notes summarizing the discussion on April 21, 1997.
- At the time of the discussion, Mr. Clapp was a retired chairman of Cascade. Mr. Clapp was the District Manager of Cascade's Bremerton district between 1968 and 1969.
- Mr. Clapp said that between 1968 and 1969, "[the] main gas holders . . . were not there, but that the main building and some of the smaller tanks on the water side of the property were still in place."
- Mr. Clapp also said that the neighbor to the south of the MGP, "Lentz, Inc." [sic], was in operation between 1968 and 1969, and the "Lentz operation next door may have included wood treatment as well as pipe storage."

Linda Baker Notes from Meeting at Site

- Linda Baker is a former consultant for Cascade. Ms. Baker was present at two meetings at the MGP site in late 1997 together with representatives of Cascade (including one of its former attorneys, Tom Lindley), the then current owners of the former MGP property, and a former worker at the MGP, Sverre Simonsen (who attended one of the meetings). At the direction of Mr. Lindley, Ms. Baker prepared a summary of the meetings on October 7, 1997.
- Mr. Simonsen, in response to a 1944 Polk Directory map showing the MGP, said: "[t]he eight tanks oriented east/west across the southern portion of the site held several products. The five northern tanks held finished gas. The three tanks to the south held 'creosote', 'bug juice' and propane. The creosote (assumed to be tarry MGP residuals) was of very high quality (4 percent water)."
- Mr. Simonsen also said, "[t]he gas holder . . . held creosote and water by-products and was maybe 15 feet deep."
- Mr. Simonsen also said, "[the] small scrubber tank was located on the north side of the gas holder (where a rectangular depression with four sections exists on the pavement)."

John West Notes Regarding Conversation With Ed White

- Ed White was a Cascade employee stationed in the Bremerton office between 1964 and 1965. Mr. West discussed the former MGP with Mr. White and prepared notes summarizing the discussion on January 26, 1998.
- Mr. White said when he worked at the Bremerton office, the structures still in place at the MGP consisted of, "an old brick building, some large tanks, and some concrete piers which supported the tanks (cradles)."
- Mr. White also said that between 1964 and 1965, "most or all the tanks were removed and the concrete piers were jackhammered and the rubble hauled away."
- Mr. White also said that between 1964 and 1965, Cascade used the MGP property to store materials such as pipe and fittings.

Hello Ralph -

I hope you are well! See 2 copies of the final summary and a strikeouts version for your review. Please keep a copy of the Final Summary and sign the other. Please also initial each page of the version you return to us.

Thank you,

Nathan

NATHAN,

4/1/14

I APPRICIATE WHAT YOU HAVE DONE IN
INTERVIEWING AND PREPARING THE SUMMARY.

THE INFORMATION IS FACTUAL.

I'M SORRY IF I CAUSED THE FINAL DOCUMENT
TO TAKE LONGER THEN ANTICIPATED.

THANKS AGAIN FOR THE EFFORT.

TAKE CARE,

Ralph

SUMMARY OF INTERVIEWS WITH MR. RALPH JUDD

BREMERTON GAS WORKS SITE

Interviewee Name:	Mr. Ralph Judd	Interviewed by:	Mark Larsen and Nathan Soccorsy, Anchor QEA, LLC
Date of Interviews:	December 20, 2013 and January 17, 2014	Memorandum Date:	March 2014

Introduction

Mr. Ralph Judd is a life-long resident of Bremerton, Washington. Nathan Soccorsy of Anchor QEA, LLC (Anchor QEA) met Mr. Judd during performance of sampling activities at the former Bremerton Gas Works Site (Site) in late 2013. Mr. Judd introduced himself as someone who had grown up in the neighborhood between the 1930s and 1950s and recalled conditions in the area and at the former gas works during that time. He offered to speak with EPA, Cascade Natural Gas Corporation and/or Anchor QEA about his recollections.

This memorandum summarizes Mr. Judd's recollections as described in two interviews with Mark Larsen (also of Anchor QEA) and Mr. Soccorsy. The interviews were conducted at Mr. Judd's home on December 20, 2013, and January 17, 2014. This interview summary is based on notes transcribed by Anchor QEA, which were reviewed and corrected by Mr. Judd on March 6, 2014.

Mr. Judd never worked at the former gas works, and has no involvement in ongoing activities at the Site. However, Mr. Judd lived and worked in the vicinity of the former gas works and described the locations and features that are depicted on Figure 1. Figure 2 is a sketch drawn by Mr. Judd in advance of the interviews and provided to Anchor QEA on December 20, 2013.

Summary

Mr. Judd lived in the vicinity of the former gas works during his youth. He was born in (b) (6) Park Avenue. His family subsequently moved to a house located at (b) Victoria Avenue (see Figure 1), several blocks south (approximately 1,800 feet) of the former gas works, where they lived from 1928 to 1936. Mr. Judd recalls

RS

walking up Thompson Avenue with (b) (6) to access a sandy beach in the area of the current Port Washington Marina, immediately west of the former gas works dock.

In 1936 his family moved to a house located at (b) (6) Naval Avenue (Figure 1), several blocks to the west of the former gas works. He and several of his childhood friends would play in the vicinity of the former gas works up until the time he entered high school in January (b) (6). As described below, the former gas works was not fenced at that time and, on occasion, he and his friends played on the former gas works property. After entering high school in (b) (6) Mr. Judd began working for the City of Bremerton. He was later employed (between August 1942 and March 1945) by the (b) (6) and/or Lents, Inc. (collectively, Lents) to work on the property located at 1723 Pennsylvania Avenue.

(b) (6) Between 1946 and 1949 he returned intermittently to the neighborhood. He left (b) (6) in September 1949 and spent most of the next year living with his family on Naval Avenue and working several summer months at the Navy ammo depot at Bangor. During that year he spent some time fishing in Port Washington Narrows in the vicinity of the former gas works, and specifically off of the former Lents dock located immediately to the east of the former gas works (Figure 1).

(b) (6)
(b) (6) returning to the neighborhood briefly during the winter of 1951. (b) (6) (October 1952), he returned to Bremerton and was employed as a helper in the naval shipyard. He later became an apprentice and his shipyard career evolved from there.

(b) (6)
While he remained a life-long Bremerton resident and was employed at the shipyard until 1985, he did not recall spending any significant time in the vicinity of the former gas works after 1957.

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Based on the foregoing history, Mr. Judd has personal recollections of conditions at the Site between approximately 1933 and 1942 (b) (6) and between late summer 1949 and September 1950 (b) (6). His recollections are less detailed between 1942 and 1949 and between 1950 and 1957. He does not have personal knowledge of conditions in the area of the Site after 1957, except what he read about in newspapers about the Site.

1. Early Recollections (1933-1936)

During this period, Mr. Judd lived at (b) (6) Victoria Avenue, and he (b) (6) occasionally played on the beach at the current location of the Port Washington Marina, just west of the former gas works. At that time, the area included a shallow sandy beach that could be accessed from Thompson Drive.

Mr. Judd (b) (6) would walk through the neighborhood from their family home down Thompson Avenue to access the sandy beach. He recalls doing this from about age 6 until about age 9.

Mr. Judd recalled that the former gas works operations were located to the east of Thompson Drive. He does not recall any gas works operations being located to the west of Thompson Drive. He recalled that area being vacant at that time.

2. Later Recollections (1936-1942)

After 1936, Mr. Judd's family lived to the west of the former gas works at their house at (b) (6) Naval Avenue (Figure 1). He had several friends in the neighborhood, including the (b) (6) and recalls playing at the former gas works property and in the vicinity. Recollections regarding specific events and areas are summarized below as communicated during the interviews.

- **Former Gas Works Property:**

- The former gas works property was not fenced during this period. Mr. Judd and his friends could walk onto the property. The sketch in Figure 2 (attached) includes his recollections of the layout of the former gas works at



that time. The sketch also includes observations from later time periods for the surrounding properties.

- Mr. Judd's recollection was that the operational areas of the former gas works were well kept and orderly.
- In approximately 1939 or 1940, Mr. Judd recalled playing at the former gas works with a friend of his (b) (6). At that time an earthen pit containing black tar was located in the southwest corner of the former gas works property, just east of Thompson Drive. The pit had sloping earthen sides and was approximately 15 feet wide and 20 to 25 feet long in the north-south direction. His friend (b) (6) fell into the pit and went home covered in tar. Mr. Judd remembers that (b) (6) got into trouble with his mother because he ruined his clothes. Mr. Judd did not know how the pit was used or what happened to the tar in the pit.
- During this period, Mr. Judd recalled walking around the former gas work property and looking into the gas machine building. He could see the gas machines through the doorway. The men who operated the gas works would periodically come out of the building with wheelbarrows full of ash and cinders. Mr. Judd recalled seeing the men dump the wheelbarrows along the ravine to the east and northeast of the former gas works and along the bluff to the north of the former gas works. There was little or no vegetation along the bluff at that time.

- **Former Gas Works Dock:**

- Mr. Judd recalled the former gas works dock located to the north of the facility and how it was used to moor and offload barges of coal. The dock was a high catwalk structure without a hand railing. He recalled seeing the barges moor along the inshore side of the dock, which presumably were positioned during high tide conditions (see Figures 1 and 2). A 3- to 4-foot-wide bucket was winched down along a cable to unload the coal. The bucket alignment could be adjusted from east to west using a hand-cranked block and tackle system on the dock. In this way, the bucket could be used to unload the entire barge without having to relocate the barge.

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- Mr. Judd recalled seeing the material unloaded, and that it was angular like fractured coal. He also recalled that when coal spilled on the beach, local residents would pick it up for their own use. Mr. Judd was aware that briquettes were used at the former gas works, but did not specifically recall unloading of briquettes at the facility.
 - Mr. Judd did not recall seeing loading or unloading of liquid products at the dock, and did not recall seeing piping on the dock. He also never accessed the dock structure, as he had a fear of heights and was not comfortable walking out on the dock, which had no railing.
 - Mr. Judd recalled that some boys from the neighborhood would go down to the former gas works dock, climb onto the pilings, and dive off into the water.
 - Mr. Judd recalled picking mussels and pile worms off the dock pilings for use as bait when fishing. At high tide he would fish for perch from a small boat near the dock and pilings. Mr. Judd did not recall seeing any spillage of tar or oil near the dock, but did recall that the pilings were made of creosote-treated timbers.
- **Intermittent Creek, Concrete Plant, and Ravine:**
 - Mr. Judd recalled that there was an intermittent creek that collected surface drainage during the wet months just to the east of Thompson Drive. The creek was small, only 1 to 2 feet across. The creek cut to the northeast across the property located at (b) (6) Pennsylvania Avenue, which is currently owned by Penn Plaza Storage LLC. In that area, the creek was still small and ran in a small ravine or ditch that was approximately 4 to 5 feet below the grade of the surrounding properties.
 - Mr. Judd recalled that people would bring trash and fill and place it in this low-lying area. He did not recall seeing any gas works operations or fill materials being placed there. This area was filled in before he began working for the Lents in August 1942.
 - The creek dropped into a deeper ravine to the east of the former gas works. There, the creek and ravine dropped toward the beach down below. He knew that this area was filled, but did not have any specific knowledge about how it



was filled or who did the filling. Mr. Judd did not recall seeing gas works wastes or tar in this area (other than the wheelbarrow dumping of ash and cinders farther north along the bluff as described above).

- Mr. Judd recalled that the concrete plant located along Thompson Drive was built around 1937 to 1939 or thereabouts.

- **Moorage and Marina:**

- Mr. Judd recalled that boats were moored along floats where the Port Washington Marina is currently located through the 1940s. He remembers live-aboards being located there during World War II.

3. (b) (6) 1942-1945)

(b) (6)

(b) (6)

he spent less time playing in the neighborhood than when he was younger.

- **Bulk Petroleum Terminals:** Mr. Judd recalled that between about 1940 and 1945, the naval shipyard expanded its western boundary and the railroad was extended from Shelton to Bremerton. Prior to that time, several petroleum facilities were located on the waterfront of Sinclair Inlet west of Bremerton. When the railroad was constructed, these facilities were required to relocate, with some operations moving near the former gas works.
 - He recollected that the former Lents dock, east of the former gas works dock, was well built and had a wooden railing. He fished off the dock at various times during the 1940s.
 - He recalled the former Richfield dock located where the Port Washington Marina is currently located. The dock was connected to an upland tank farm by above-ground pipelines that ran along the wooded area at the west side of the property located at 1701 Thompson Drive, which was formerly owned by Richfield Oil Corporation and operated as a petroleum storage and distribution facility. Mr. Judd recalled that Gene Lobe owned the Richfield franchise in Kitsap County, and he remains a resident in the area.



- Mr. Judd remembers seeing oil barges unloaded at the former Lents and Richfield docks, and that it was common to see episodic oil sheening on the water along the beach when the barges were at the docks.
- Mr. Judd recalls another oil terminal that was formerly located farther west of the Port Washington Marina at Anderson Cove.
- **Sailor Jack:** Mr. Judd recalled that a man known as "Sailor Jack" had a small floating boat house located northeast of the end of Pennsylvania Avenue, just north of the property located at 1702 Pennsylvania Avenue, which is currently operated by SC Fuels as a petroleum storage and distribution facility. He recalls that the boat house had a roof, and there was a stairway down to the beach.
- **Working at Lents (1942-1945):** Mr. Judd worked for the Lents between August 1942 and March 1945. He worked in several different positions, as described below:
 - In the sheet metal shop (located along Pennsylvania Avenue), Mr. Judd conducted assembly of metal products. The sheet metal shop was a two-story building, including both the machine shop and warehouse. Mr. Judd recalled that there was a small plating operation located along the western side of the metal shop. Metal products were cleaned in a tank containing lye.
 - He recalled Fred Gessup, who managed the oil deliveries for the Lents. Mr. Judd's cousin worked with Mr. Gessup as an office assistant. The oil delivery trucks were parked and cleaned outside of the main building. The trucks would be loaded with fuel at the tank farms north of the main building.
 - (b) (6) lived in the house located just northeast of the tank farms around this time. The "house" shown on Figure 2 is the approximate location of (b) (6) residence.
 - One summer Mr. Judd worked in the warehouse and yard as a swamper (laborer). His job included assisting with deliveries and picking up appliances for repair at the Lents facility.
 - Mr. Judd also worked a few months in the winter of 1942 to 1943 in the paint shop located along Thompson Avenue. He remembers making first-aid boxes



for the military and wearing respirators. His job was to fill and repair dings and other defects.

4. (b) (6) [redacted] 1949-1950)

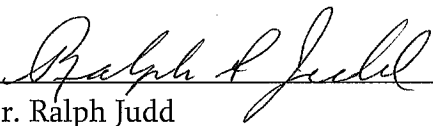
Between late summer 1949 and September 1950 (b) (6) [redacted] Mr. Judd lived (b) (6) [redacted] on Naval Avenue. He recalls fishing off the former Lents dock during this period. It was used for oil unloading at that time. He did not recall fill activity in the area at that time, and noted that there was not much room for filling with the tank farm and (b) (6) [redacted] house on one side, and the former gas works on the other. He did not recall seeing spills of oil, tar, or other materials in the area, though he was mostly interested in the dock for fishing. He recalls that the dock was wooden and had a railing. He did not recall what the piping looked like on the dock, though he remembered seeing oil barges unloading at the dock.

5. Other Regional Recollections

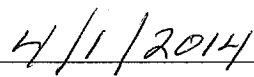
- Mr. Judd did not recall any organized landfilling activity at the ravine east of the former gas works or along the intermittent creek east of Thompson Drive. He did, as noted above, recall seeing miscellaneous garbage and fill dumped along the creek prior to 1942 when he began working for the Lents. By then, the creek in this area had been filled.
- Mr. Judd recalled that during the 1930s there was a landfill located farther east, where Roosevelt Field is now. It was in a low spot and the garbage would occasionally catch fire. He recalled that people would salvage food and jars from the dump during the depression. Later, bachelor housing and a community center were built over the dump. One of the buildings settled and had to be torn down.

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This interview summary and the attached Figure 1 are consistent with my recollections as communicated during my interviews with Anchor QEA:



Mr. Ralph Judd

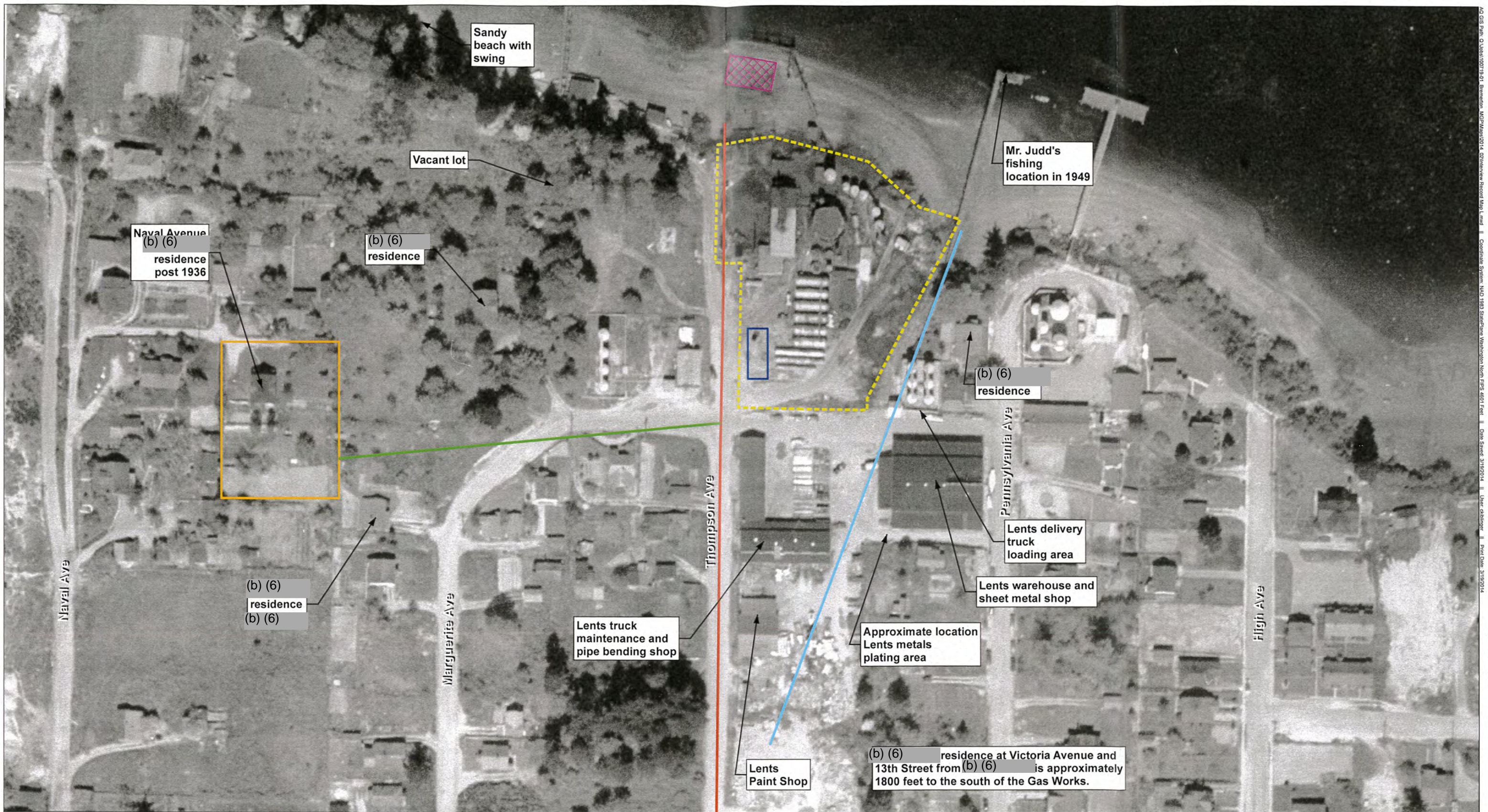


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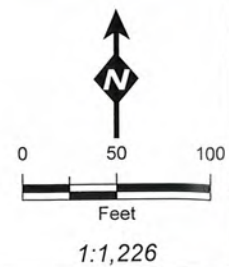
FIGURES

RL



- Approximate location of intermittent stream
- Walking route to beach circa 1933
- Walking route to beach from 1936 to 1942
- Coal barge mooring area
- Judd property boundary (approx.)
- Approximate Vicinity of 15-ft x 25-ft Tar Pit
- Former Gas Works Location

NOTE:
1946 aerial photograph.



Ralph Judd Interview Summary Map

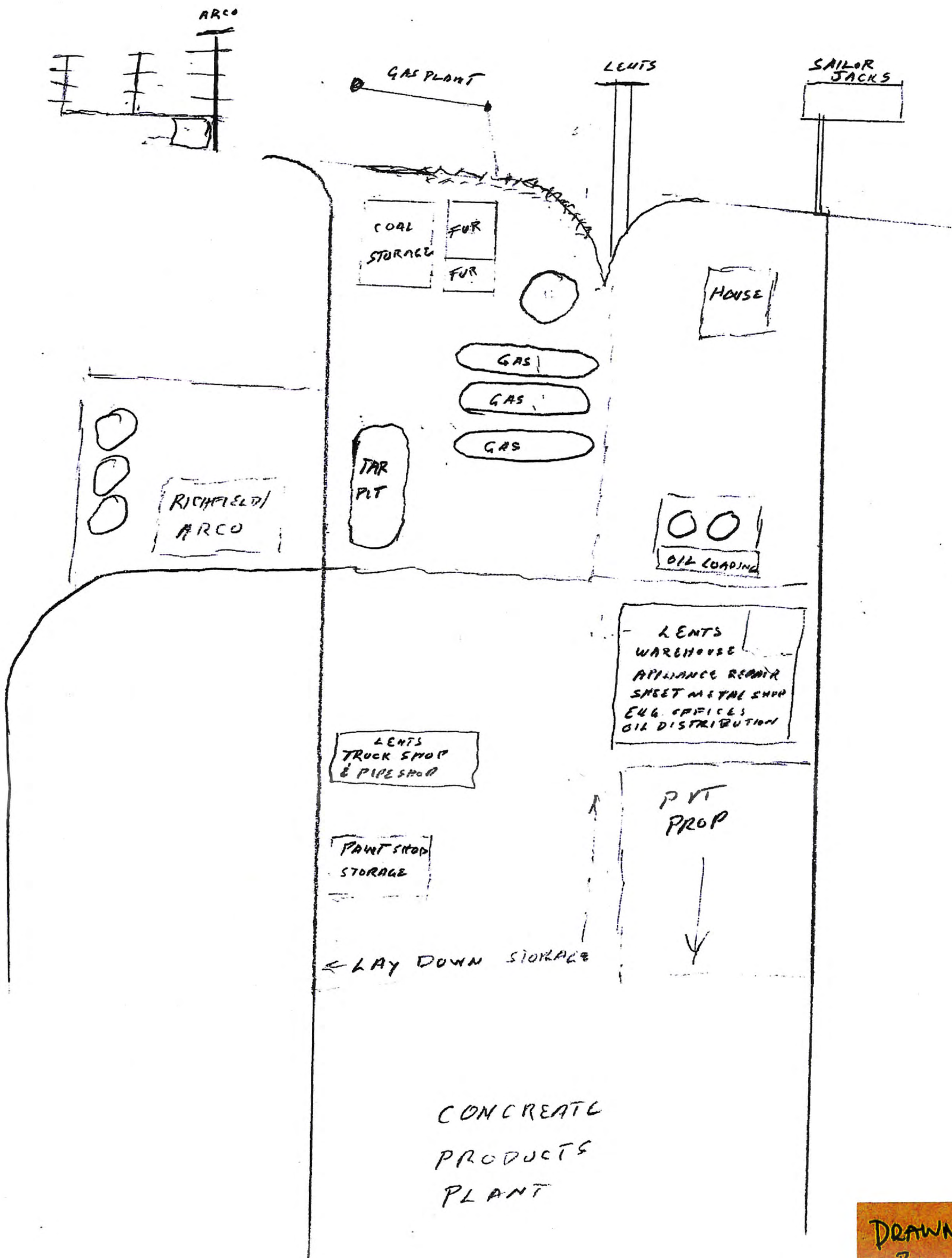
Bremerton Gas Works
Bremerton, Washington

Aspect
CONSULTING

ANCHOR
QEA

FIRM:
ANCHOR QEA
DRAWN BY:
ckiblinger

FIGURE NO.
1



DRAWN BY:
RALPH JUDD

GIVEN TO:
MARK LARSEN
NATHAN SOCCORSY
12/20/2013

NOTES:
1. This depiction presents features and recollections over multiple dates.
2. Not to scale.

Ralph Judd Sketch
Bremerton Gas Works
Bremerton, Washington

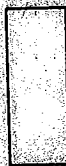
R. Judd

THOMPSON

PENNSYLVANIA

DRIP TANK 2" LENTS PIPE SHOP

GAS PLANT



18.00

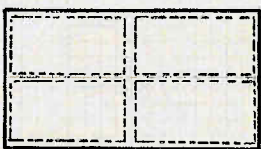
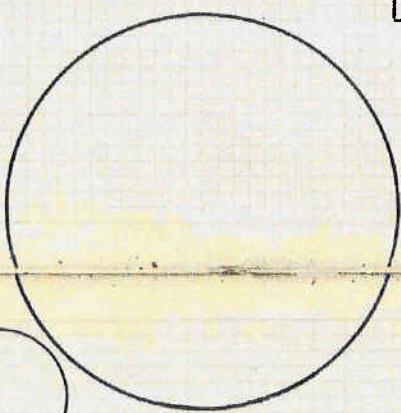
80.5

170.1

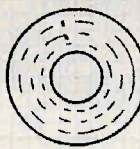
WASHINGTON N

24,000 Gal.
OIL
TANK

SCRUBBER



TAR WALLS



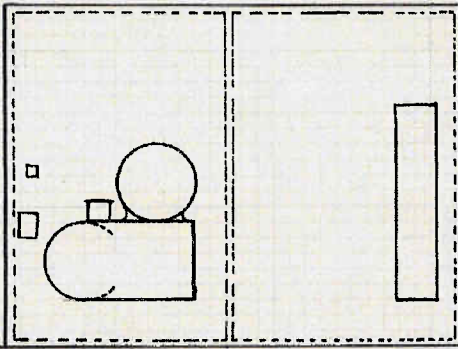
RESIDUE
CISTERN

Purifier

Purifier

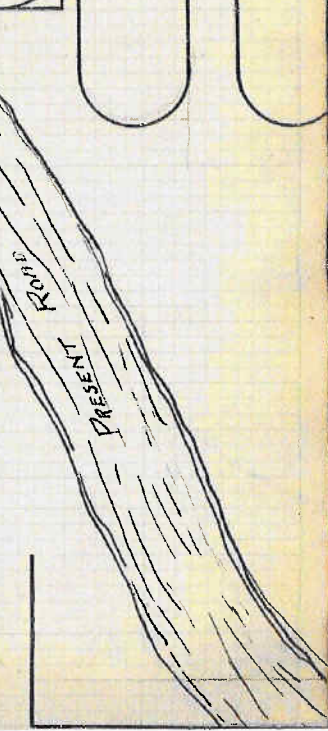
Purifier

HOIST
HOUSE

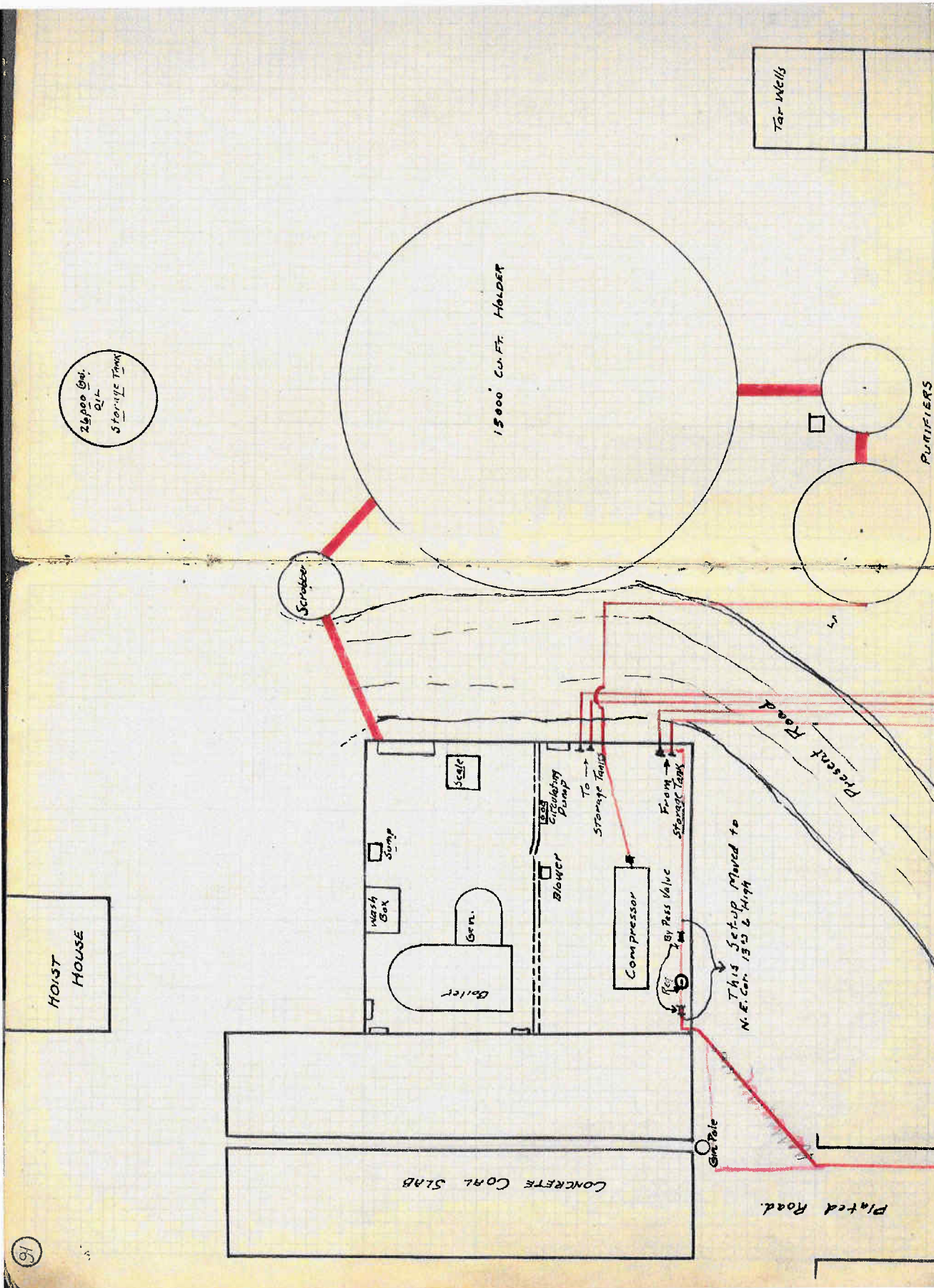


COAL
SLAB

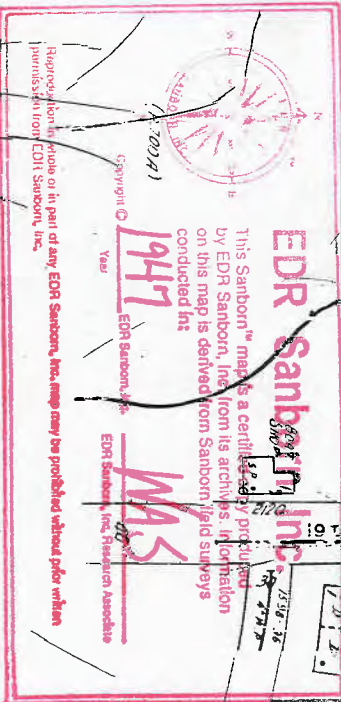
GIN POLE



PURIFIER
RIVER



(b)(4) copyright



(b)(4) copyright



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1946 Aerial Photograph



1956 Aerial Photograph



1961 Aerial Photograph



1965 Aerial Photograph



1971 Aerial Photograph



APPENDIX D

DNR Lease History Documents

September 15, 2014

To: Bill Ryan, EPA

From: Rolin Christopherson, Washington State Department of Natural Resources

Draft Summary:

Lease History in Vicinity of Old Bremerton Gas Works

Area of Industrial Land Use outside of the Parcels of Interest

The Bridgeview Marina Inc. Harbor Area: The Bridgeview Marina (formerly known as the Seven J's or Port Washington Marina) is located 3.487 acres of harbor area fronting Government Lots 6 and 7, Section 11, Township 24 North, Range 1 East, W.M., between Waterway No. 4 on the west and Renn Stroll on the east.

Harbor area lease 1044 was issued to C.G. Hansen. The leased area (approximately 3.3 acres) fronted parts of Lots 6 and 7, Township 24 North, Range 1 East. The proposed improvements were: "a dragway or grid for hauling small boats out of the water." Harbor area lease 1044 had a term of 10 years commencing on November 1, 1934. Harbor area lease 1312 was issued to C.G. Hansen for a term of 10 years commencing on November 1, 1944. The lease area included the 450 feet of the eastern portion of the previous lease 1044.

The harbor area on the eastern portion of the Hansen lease area eventually became occupied by the Tidewater Oil Company and William M. Slonecker. This portion of the harbor area was once home to petroleum terminals that serviced upland tank farms for the Tidewater/Phillips Oil Companies adjacent to the waterway, and the Richfield Oil Company located east of Renn Stroll.

Tideland Oil: Oil companies have leased 0.45 acres of harbor area fronting lot 6, section 11, township 24 north, range 1 east and Waterway No. 4 from the date of assignment from Emma Annie Akers to the Petroleum Navigation Company on May 7, 1946 to May 6, 1976. The Tidewater Oil Company built a 100 feet long by 10 feet wide dock with two dolphins at the end of the dock, which carried petroleum pipelines to the bulk plant on the adjacent uplands.

On May 7, 1946, harbor area lease 1348 was issued to Emma Annie Akers for a 10 year term. On September 4, 1946 lease 1348 was assigned to Petroleum Navigation Co. On March 8, 1948 lease 1348 was assigned to the Tide Water Associated Oil Company. On May 7, 1956 harbor area lease 1615 was issued to Tide Water Associated Oil Company for a ten year term. On August 31, 1956, Tide Water Associated Oil Company sent notification that their corporate name has been changed to Tidewater Oil Company.

Philips Petroleum Company had purchased portions of the Tidewater Oil Company on July 15, 1966. On September 16, 1966 lease 1615 was assigned to Philips Petroleum Company. Harbor area lease 2027 was

issued to Philips Petroleum Company on May 7, 1966 for a ten year term. Lease 22-002399 was issued to William R. Dane for a ten year term commencing on May 7, 1976. On May 23, 1983, lease 2399 was amended to amend its expiration date to November 1, 2004. On May 26, 1983, lease 2399 was assigned to Port Washington Properties. On December 14, 1983, lease 2399 was assigned to Port Washington Marina Condominium Owners Association. The leasing chronology for this site:

• Harbor area lease 1348	Emma Annie Akers	May 7, 1946-1956
• Assignment to	Petroleum Navigation Company	September 4, 1946
• Assignment to	Tide Water Associated Oil Company	March 8, 1948
• Harbor area lease 1615	Tide Water Associated Oil Company	May 7, 1956-1966
• Name change to	Tidewater Oil Company	August 31, 1956
• Assignment to	Philips Petroleum Co.	September 16, 1966
• 22-002027	Philips Petroleum Co.	May 7, 1966-1976
• 22-002399	William Dane	1976-2004
• Assignment to	Port Washington Properties	May 26, 1983
• Assignment to Port Washington Marina Condominium Owners Association		December 14, 1983
• 22-002332	Port Washington Marina Owners	August 1, 1993-2023
• Assignment to	Seven J's Investments	December 11, 2003
• 22-A02332	Seven J's Investments	December 1, 2004-2034
• Assignment to	Bridgeview Marina Inc.	May 28, 2014

Slonecker Lease Area: C.G. Hansen reduced his lease area (lease 1044), and William Slonecker applied to lease 0.79 acres of harbor area for a “boat house and marine ways” on December 15, 1944. W.M. Slonecker and Helen S. Slonecker sublet the harbor area to Carl G. Lundgren and Frank J. Taylor, doing business as Peninsula Boat Works, on June 19, 1946 for the purpose of “operating and maintaining a boat works.”

Harbor area lease 1342 was issued to W.M. Slonecker for a 10 year term commencing on March 26, 1946. Harbor area lease 1625 was issued to W.M. Slonecker for a 10 year term commencing on March 26, 1956. Lease 22-002018 was issued to Helen S. Slonecker for a 10 year term commencing on March 26, 1966, (lease was cancelled on March 23, 1972). Lease 22-002396 was issued to Sea Gate, Inc. for a 28 year term commencing on November 1, 1976.

By 1988, the Port Washington Marina Owners Association requested the consolidation of leases 2332, 2396 and 2399. Lease 2396 was terminated on July 31, 1993 as part of a lease consolidation, and the harbor area was included in the lease area of 22-02332 which is currently under lease to Bridgeview Marina Inc.

In vicinity of former ARCO dock

The Cary and Richfield Oil Leases: Richfield Oil sublet 0.75 acres harbor area fronting lot 7, section 11, township 24 north, range 1 east from C.G. Hansen and Vern Cary with H.G.R. Connors and Willa

Carey from 1942 to 1954. Between 1954 and 1974, Richfield Oil leased that harbor area directly from the State.

The former Richfield Tank Farm, was located on parcel 009-00 and was connected to the Harbor Area by a pipeline located over the western portion of parcel 010-00 (a portion of the pipeline may have been located on parcel 3-098). The Harbor Area leased by Richfield is now a portion of the Bridge View Marina (former Port Washington Marina).

The Cary and Richfield harbor area was originally part of the Hansen harbor area lease 1312. Lease 1312 was assigned to Vern Carey and H.G.R. Conners on November 19, 1950. The improvements in the leased area are described as a “small boat moorage operated by Bremerton Marine Service also 2-bedroom house used as office and living quarters, 1-work shop...” and an oil dock claimed by the Richfield Oil Co.

On October 30, 1954, the Vern and Willa Carey assigned all their right, title and interest in the easterly 150 feet, or 0.75 acres of leased harbor area as measured on the inner harbor line from the west line of Lot 11, Supplemental Plat of Bay View Garden Tracts to the Richfield Oil Corporation. This assignment was made subject to an agreement and sublease between the Richfield Oil Corporation and the Careys that granted the Careys the right to use the premises “to keep and maintain their work shop, storage shed, office and living quarters, cat walks and floats on said property during the term of this sublease and any extensions hereof.” This agreement allowed joint occupation of the harbor area by Richfield Oil and the Careys over which the Richfield Oil pipeline crossed.

Harbor area lease 22-001971 was issued to the Richfield Oil Corporation commencing November 1, 1964 for a ten year term. In 1974, The Atlantic Richfield Corporation successor by merger to Richfield Oil Corporation, cancelled lease 22-001971. Harbor Area Leasing Chronology:

• Harbor area lease 1044	C.G. Hansen	November 1, 1934-1944
• Harbor area lease 1312	C.G. Hansen	November 1, 1944-1954
• Assignment to	Vern Carey & H.G. R. Conners	November 18, 1950
• Assignment to	Willa Carey	October 10, 1952
• Harbor area lease 1548	Vern and Willa Carey	November 1, 1954-1964
• Harbor area lease 1553	Richfield Oil Co.	November 1, 1954-1964
• 22-001971	Richfield Oil Co.	November 1, 1964-1974
• 22-001974	Vern and Willa Carey	November 1, 1964-1974
• 22-002332	Port Washington Marina	November 1, 1974-2023
• Assignment	Seven J's Investments	December 11, 2003
• 22-A02332	Seven J's Investments	December 1, 2004-2034
• Assignment to	Bridgeview Marina Inc.	May 28, 2014

The Snow Lease (22-002332): The former Vern and Willa Carey lease area (22-001974) with the former Richfield Oil lease area (22-001971) was combined into lease 22-002332 for the use of approximately 2.0 acres of harbor area. Lease 22-002332 was issued to Darwin L. Snow and Susan J. Snow commencing on November 1, 1974 for a 30 year term.

- 22-002332 Darwin L. Snow and Susan J. Snow November 1, 1974 – 2004
- Assignment to Sharon E. Snow January 28, 1976
- Assignment to Sea Gate, Inc. August 4, 1976
- Assignment to Sea Brim Inc. September 14, 1981
- Assignment to Port Washington Properties May 31, 1983
- Assignment to Port Washington Marina Condominium Owners Association December 14, 1983

In vicinity of former Gas Works dock

Western Gas Company leases (Harbor area leases 935 and 1352): has leased 1.85 acres of harbor area fronting the Bay View Garden Tracts from 1930 to 1959. After 1959, this harbor area was leased by John B. Verhelst until December 11, 1975 and then by John C. Verhelst and Franklin Cooper until May 31, 1983. In May 1983, the Port Washington Properties assumed the lease for this harbor area and developed a marina over the western portion of this lease area. In 1993, this portion of the harbor area located west of Renn Stroll was merged with other harbor area located to its west and leased to the Port Washington Marina Condominium Owners Association.

Verhelst leases (22-001783, 22-002141, and 22-002523): John B. Verhelst leased 1.88 acres of harbor area fronting tracts 1 and 11 and intervening Renn Stroll, Supplemental Plat of Bayview Garden Tracts for a 10 year term commencing December 8, 1959, for the purpose of a “Bulk Plant Site.”(22-001783).

Western Gas Company harbor area leases chronology:

- | | | |
|--------------------------|---------------------------------------|--|
| • Harbor area lease 935 | Western Gas and Utilities Corp. | 1930-1945 |
| • Harbor area lease 1352 | Western Gas Co. of Washington | 1945-1960 |
| • Lease Cancelled | | February 10, 1959 |
| • 22-001783 | John B. Verhelst | December 8, 1959-1969 |
| • 22-002141 | John B. Verhelst | October 17, 1969-1979 |
| • Assignment to | Franklin R. Cooper & John C. Verhelst | January 9, 1976 |
| • 22-002523 | Franklin R. Cooper & John C. Verhelst | December 8, 1979-1989 |
| • Assignment to | Port Washington Properties | June 13, 1983-1993 |
| • Assignment to | Jack T. Champion | July 15, 1987, expired on December 8, 1989 |
| • 22-002332 | Port Washington Marina Condo Owners | 1993 |
| • Assignment to | Seven J's Investments | December 11, 2003 |
| • 22-A02332 | Seven J's Investments | December 1, 2004-2034 |
| • Assignment to | Bridgeview Marina Inc. | May 28, 2014 |

Port Washington Marina Lease (22-002332): The Port Washington Marina lease area is comprised of four former lease areas: lease 2332; lease 2339; lease 2396; and the western portion of lease 2523 consolidated between 1982 and 1993 into a new harbor area lease 22-002332 containing 3.487 acres. This harbor area was historically used in conjunction with the former Tideland Oil and Richfield Oil tank farms as well as the western portion of the former Washington Gas Co. facility.

Port Washington Marina Condominium Owners Association Marina: In 1983, the Marina was constructed over the three adjacent lease areas 2332, 2396 and 2399. All of these leases were assigned to Port Washington Properties in May 1983. Lease 22-002332 was assigned to Port Washington Marina Condominium Owners Association on December 14, 1983. Harbor area lease 2332 with Port Washington Marina Condominium Owner's Association which combined leases 2332, 2396, and 2399 into one lease was executed on August 1, 1993 for a term of 30 years, for "maintaining finger floats, docks, and fixed piles to provide vessel moorage for a privately-owned and operated marina..." The new lease would extend from Waterway No. 4 to Renn Stroll, Supplemental Plat of Bay View Garden Tracts, in harbor area previously leased by the Western Gas Co.

On November 14, 1995, lease 22-002332 was assigned to Douglas Faulds and Donna Ernst. On December 18, 2003, harbor area lease 2332 was assigned to Seven J's investments. A new harbor area lease 22-A02332 was executed with Seven J's Investment for a thirty year term commencing December 1, 2004 for the use of "recreational and commercial vessel moorage and a marine pump out facility..."

Bridge View Marina (22-A02332): The Port Washington Marina lease, 22-A02332, held by Seven J's Investments was assigned to Bridgeview Marina Inc. a Washington corporation effective May 28, 2014.

Port Washington Marina Harbor Area Lease Chronology:

• 22-002332	Darwin L. and Susan J. Snow	November 1, 1974-2023
• Assignment to	Port Washington Properties	May 31, 1983
• Assignment to	Port Washington Marina Condo Owners	December 14, 1983
• Termination of	Harbor Area Leases 2332, 2996. 2999	August 1, 1993
• 22-002332	Port Washington Marina Condo Owners	August 1, 1993-2023
• Assignment to	Douglas Faulds & Donna Ernst	November 14, 1995
• Assignment to	Seven J's Investments	December 18, 2003
• 22-A02332	Seven J's Investments	December 1, 2004-2034
• Assignment to	Bridgeview Marina Inc.	May 28, 2014

Harbor area and beds of navigable water directly north of Thompson Drive

Cascade Natural Gas Corporation easement (51-037928): June 24, 1975, a perpetual easement was issued to Cascade Natural Gas Corporation for harbor area and beds of navigable water extending directly north of Thompson Drive and Renn Stroll in order to construct a salt water cathodic protection groundbed for protection of a portion of its distribution system in Bremerton.

In vicinity of former Sesko dock

Lent's (harbor area lease 2716) has leased 0.3 acres of Harbor Area fronting Tract 23 and Pennsylvania Avenue of John Daly's Garden Tracts and located in Lot 1, Section 14, T 24 N R 1 E, WM, and W ½ of Pennsylvania Avenue from 1938-1998.

Harbor area lease 1123 was issued to Duncan Clark on January 25, 1938 for harbor area fronting a portion of lot 1, section 14, township 24 north range 1 east between the west line of Tract 23 and the center line of Pennsylvania Avenue of John Daly's Garden Tracts for a ten year term. Harbor area lease 1123 was assigned to Ernest R. Lent, Theodore Blomberg and Harold D. Lent on January 12, 1942. Lease 1393 was issued to Lent's Partnership (Ernest R. Lent, Theodore Blomberg and Harold D. Lent) for a ten year term commencing January 25, 1948. On December 21, 1953, lease 1393 was assigned to Lent's Inc.

Harbor area lease 1675 was issued to Lent's Inc., for a ten year term commencing on January 25, 1958. The lease was for the purpose of "oil barge facilities—dock and pipeline leading to our storage tanks". Lent's Inc. released under lease 2071 for a ten year term commencing on January 25, 1968. Lent's Inc. released under lease 2542 for a ten year term commencing on January 25, 1978.

On December 11, 1979, Theodore and Marian J. Blomberg sold the uplands (a portion of Lot 1, Supplemental Plat of Bayview Garden tracts, and Tract 23 of John Daley's Garden Tracts) to F. Paul and Margaret M. McConkey. The conveyance did not include the first class tidelands (harbor area) in front of the property. It should be noted that the real estate contract was subject to the following easements:

- Easement for sewer pipes Auditor's file Nos. 301882 and 305863
- Easement for sewer Auditor's file Nos. 308382 and 353788
- Easement for sewer Auditor's file No. 585812
- Easement for sewer pipe Superior Court Cause No. 26012
 - Auditor's file no. 588972
- Deed and perpetual easement Auditor's file No. 336749

On November 1, 1980, Lent's Inc., by Theodore C. and Marian J. Blomberg as owners of "easements for access, operation, maintenance, installation, removal, repair and servicing of a certain oil dock, and underground oil and gasoline supply lines", transferred those easements to Service Fuel Co., Inc. in conjunction with the transfer of the assets of Lent's Inc. oil department. On March 10, 1981, lease 2452 was assigned to the Service Fuel Co., Inc., owned by James Bennett. On July 6, 1988, James and Dorothea Bennett, as a result of bankruptcy proceedings, quit claimed all interest in the property to the Wilkins Distributing Co., Inc. On January 25, 1988, Wilkins Distributing Company was issued lease 22-002716 for a ten year term for the "purpose of off-loading fuel barges". On November 18, 1996, Wilkins Distributing Company requested that Lease 2716 be terminated.

Harbor Area Lease Chronology:

- | | | |
|--------------------------|--------------------------------|-----------------------|
| • Harbor area lease 1123 | Duncan J. Clark | January 25, 1938-1948 |
| • Assignment to | E. Lent, H. Lent & T. Blomberg | January 12, 1942 |
| • Harbor area lease 1393 | E. Lent, H. Lent & T. Blomberg | January 25, 1948-1958 |
| • Assignment to | Lent's Inc. | December 21, 1953 |
| • Harbor area lease 1675 | Lent's Inc. | January 25, 1958-1968 |
| • 22-002071 | Lent's Inc. | January 25, 1968-1978 |
| • 22-002452 | Lent's Inc. | January 25, 1978-1988 |
| • 22-002716 | Wilkins Distributing Co. | January 25, 1988-1998 |
| • Cancelled | | November 18, 1996 |

Former SC Fuels Dock

General Petroleum and its successors leased 0.69 acres of Harbor Area fronting Tract 1 and E ½ of Pennsylvania Avenue, Joseph Daly’s Garden Tracts in Lot 1, Section 14, Township 24 North, Range 1 East from 1942 to 1972. This leased harbor area was located immediately adjacent to the Lent’s harbor area use. The harbor was used by General Petroleum and Socony Mobil Oil for a thirty year period for handling petroleum products. A 4” pipeline for stove and diesel fuel, and a 4” pipeline for gasoline were placed on the dock to off-load product from barges to a tank farm located upland.

Harbor area lease 1124 was issued to John P. Kuphal for a ten year term commencing on March 18, 1938, for the purpose of mooring small boats and anchorage. On October 14, 1942, the General Petroleum Corporation of California applied to lease the harbor area fronting Tract 1 of John Daly’s Garden Tracts for the purpose of constructing a “dock for handling petroleum products.” Lease 1124 was assigned from John P. Kuphal to General Petroleum Corporation of California on December 16, 1942. On May 5, 1943, lease 1124 was cancelled and a new lease was issued to General Petroleum Corporation of California for a 10 year term commencing on March 18, 1943. Lease 1507 was issued to General Petroleum Corporation of California for a 10 year term commencing on August 18, 1953.

On January 14, 1960, the General Petroleum Corporation was merged into its parent company Socony Mobil Oil Company, Inc. Lease 22-001920 was issued to Socony Mobil Oil Company for a 10 year term commencing on March 18, 1963. On March 17, 1972 at the request of Mobil Oil Corporation lease 22-001920 was terminated.

Harbor Area Lease Chronology

• Harbor area lease 1124	John P. Kuphal	March 18, 1938-1948
• Assignment to	General Petroleum Co. of Cal.	December 16, 1942
• Lease cancelled		May 5, 1943
• Harbor area lease 1280	General Petroleum Co. of Cal.	March 18, 1943-1953
• Harbor area lease 1507	General Petroleum Co. of Cal.	August 18, 1953-1963
• Name change to	Socony Mobil Oil Company, Inc.	1960
• 22-001920	Socony Mobil Oil Company, Inc.	March 18, 1963-1973
• Lease Cancelled		March 17, 1972

City of Bremerton Sewer
















The City of Bremerton has constructed a sewer line that transits in and out of waterway and harbor area fronting both Sections 11 and 14 of Township 24 North Range 1 East. On October 28, 1983, the City of Bremerton was issued an easement (51-045730) for the construction, operation, use and maintenance of a sanitary sewer line.

APPENDIX E

Boring and Well Logs

GAS WORKS BORING LOGS

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES	
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES	
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
	MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
					SP	POORLY-GRADED SANDS, GRAVELLY SAND
		MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
					SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY	
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
					CH	INORGANIC CLAYS OF HIGH PLASTICITY
					OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

	2.4-inch I.D. split barrel
	Standard Penetration Test (SPT)
	Shelby tube
	Piston
	Direct-Push
	Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS		TYPICAL DESCRIPTIONS
GRAPH	LETTER	
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/Quarry Spalls
	TS	Topsoil/Forest Duff/Sod



Measured groundwater level in exploration, well, or piezometer



Groundwater observed at time of exploration



Perched water observed at time of exploration



Measured free product in well or piezometer

Stratigraphic Contact

	Distinct contact between soil strata or geologic units
	Gradual change between soil strata or geologic units
	Approximate location of soil strata change within a geologic soil unit

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

Date(s) Drilled	05/21/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	46.5	Surface Elevation (ft)	45.03	Groundwater Elevation (ft)	7.03
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	

Elevation feet	Depth feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
		Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
45	0								AS	Asphalt			
									ML	Brown silt with fine sand and fine gravel (loose, wet) (fill)			
40	5	18	30		1	CA			ML	Brown silt with fine sand (very stiff, moist) (fill)	NS	0.0	
35	10	18	48		2				SM	Brown silty fine to medium sand (very dense, moist)	NS	42.9	
30	15	18	65		3						NS	17.3	
25	20	18	44		4				SM	Brown silty fine to medium sand (very dense, moist)	NS-SS	26.0	
20	25	18	72		5				SP-SM	Brown fine to medium sand with silt (very dense, moist)	NS	42.3	
30													

Note: See Figure A-1 for explanation of symbols.

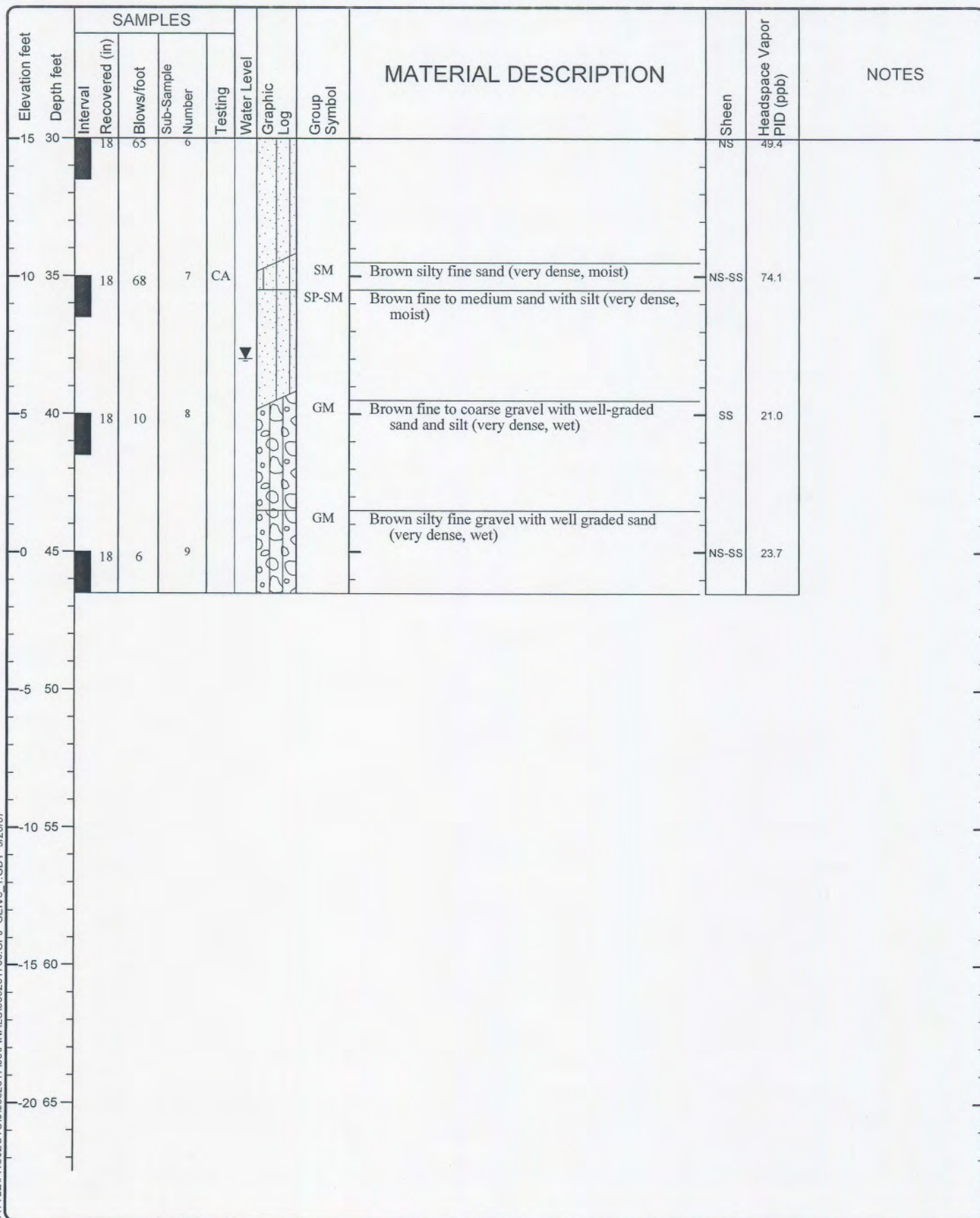
LOG OF MONITORING WELL MW-1



Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-2
Sheet 1 of 2

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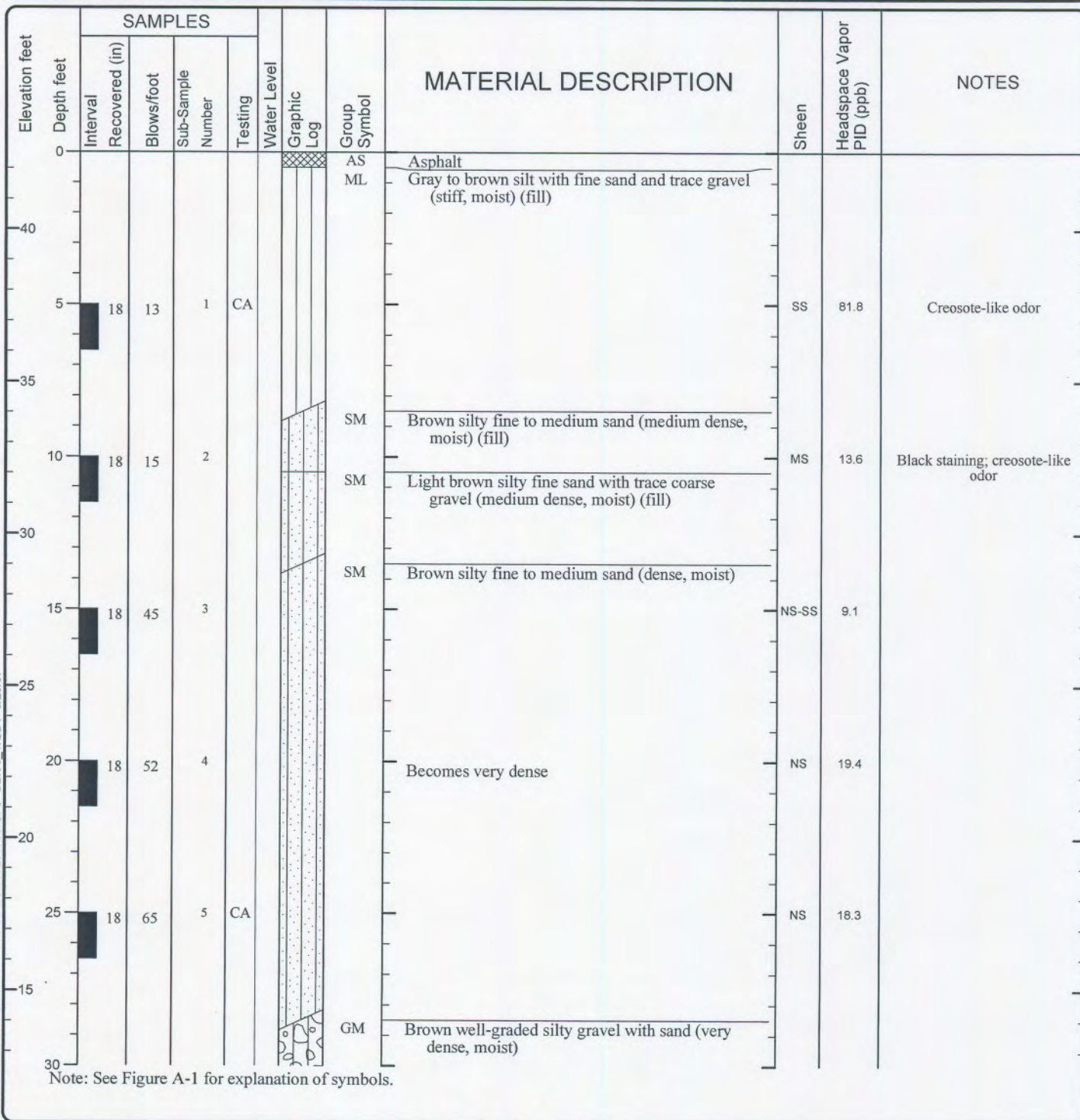
LOG OF MONITORING WELL MW-1 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-2
 Sheet 2 of 2

Date(s) Drilled	05/21/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	46.5	Surface Elevation (ft)	42.54	Groundwater Elevation (ft)	4.54
Vertical Datum		Datum/ System	NAVD88	Easting(x): Northing(y):	



LOG OF MONITORING WELL MW-2

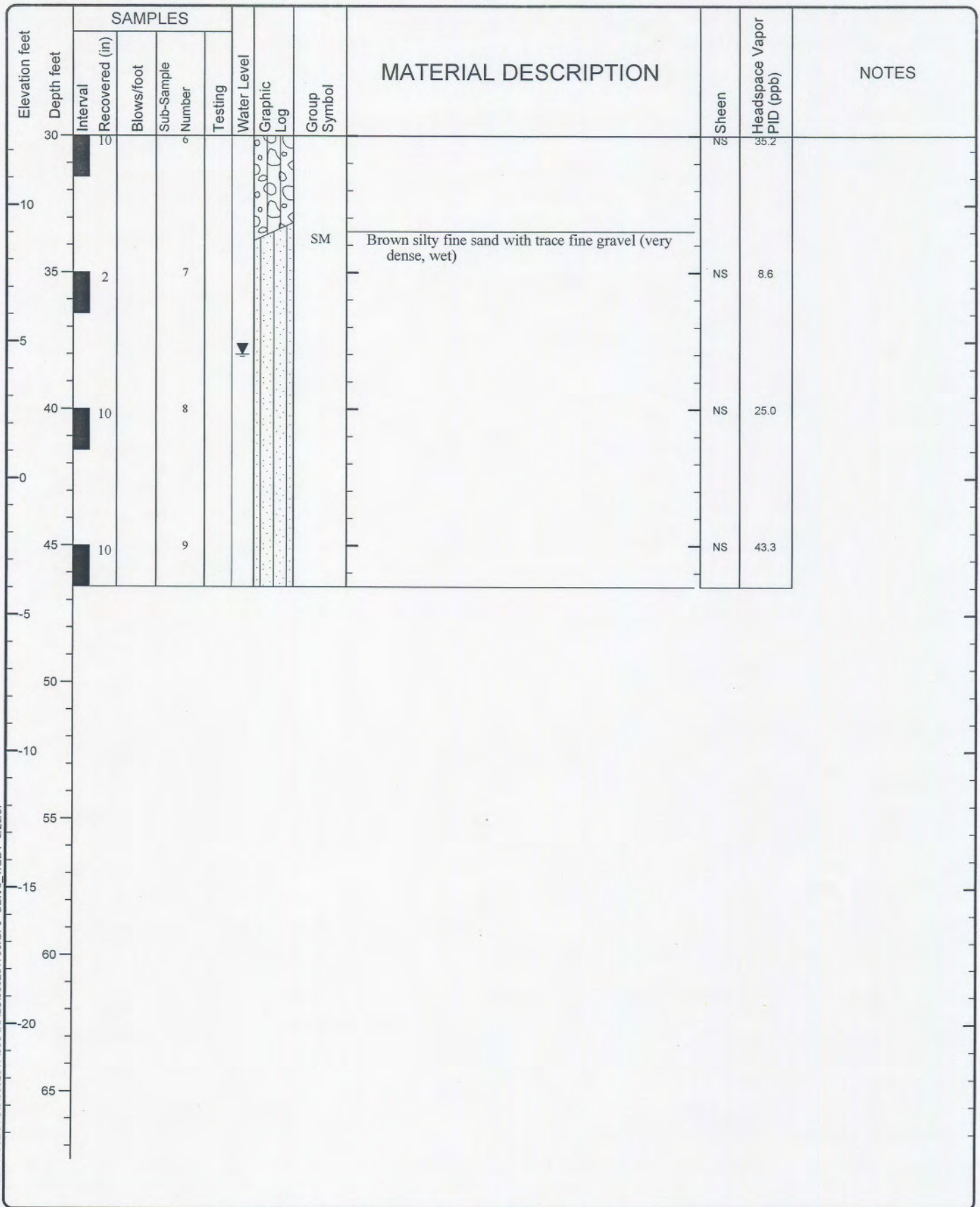


Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

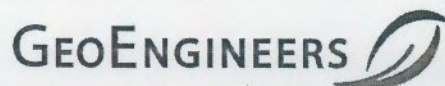
Figure A-3
 Sheet 1 of 2

V6_ENVBORING W:\SEATTLE\PROJECTS\0892017\000\FINAL\S\089201700.GPJ GEIV6 1.GDT 9/20/07

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LOG OF MONITORING WELL MW-2 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-3
 Sheet 2 of 2

Date(s) Drilled	05/22/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	46.5	Surface Elevation (ft)	39.10	Groundwater Elevation (ft)	4.1
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	

Elevation feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
0								AS	Asphalt			
								SM	Brown silty fine to medium sand with occasional gravel (dense, moist) (fill)			
35												
5	18	25	1	CA				ML	Gray silt with fine sand and occasional gravel (very stiff, moist) (fill)	SS	>2,000	Dark staining creosote-like/solvent odor
30												
10	18	48	2					SM MH	Brown silty fine to medium sand (very dense, moist) Brown silt with fine to medium sand (hard, moist)	SS-NS	469	Dark staining
25												
15	18	45	3					SM	Brown silty fine to medium sand with occasional gravel (very dense, moist)	NS-SS	32.1	
20												
20	18	52	4							NS	903	
15												
25	18	62	5	CA				SP-SM	Gray fine to medium sand with silt (very dense, moist)	NS	>2,000	
10												
30								SM	Gray silty fine to medium sand (very dense, moist)			

Note: See Figure A-1 for explanation of symbols.

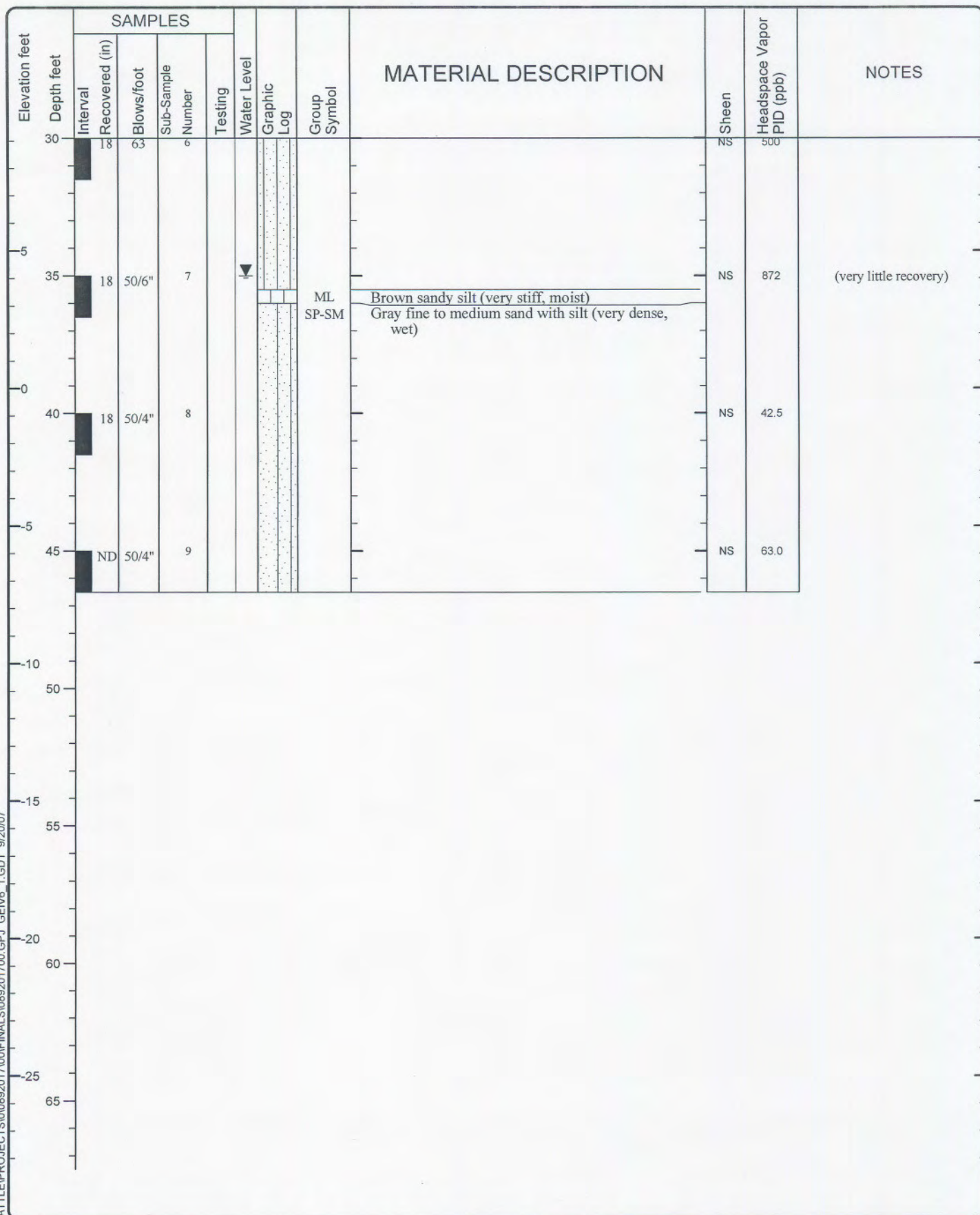
LOG OF MONITORING WELL MW-3

GEOENGINEERS

Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-4
Sheet 1 of 2

V6_ENVBORING W:\SEATTLE\PROJECTS\010892017\001\FINAL\S\089201700.GPJ GEV6 1.GDT 9/20/07



LOG OF MONITORING WELL MW-3 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-4
 Sheet 2 of 2

Date(s) Drilled	05/23/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	41.5	Surface Elevation (ft)	35.20	Groundwater Elevation (ft)	6.2
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	

Elevation feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
35	0							GM	Brown silty well-graded gravel with well-graded sand (medium dense, moist) (fill)			
30	5	16	18	1						SS	35.9	
25	10	18	18	2						NS-SS	94.9	
20	15	18	58	3	CA			SM	Dark brown to black silty fine to medium sand with gravel (very dense, moist) (fill)	HS	76.9	
15	20	18	63	4				ML	Black to gray silt with sand and gravel (very stiff, moist)			
10	25	18	65	5				ML	Brown to gray sandy silt (hard, moist)	NS-SS	12.2	
								ML	Gray silt with trace fine sand (hard, moist)			
30								GM	Gray silty well-graded gravel with well-graded sand (very dense, wet)	NS	128	(diesel odor)

Note: See Figure A-1 for explanation of symbols.

LOG OF MONITORING WELL MW-4

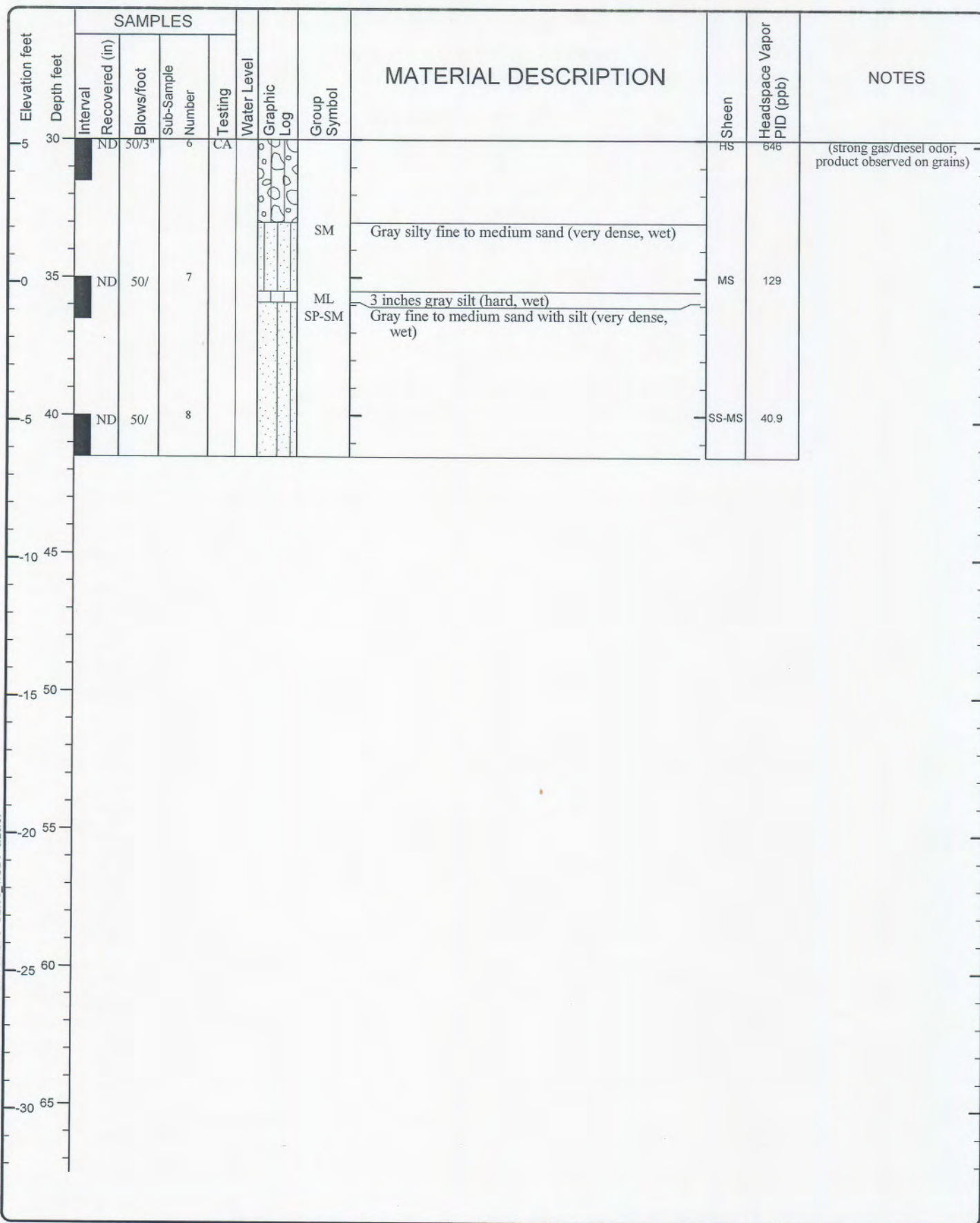
GEOENGINEERS

Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-5
Sheet 1 of 2

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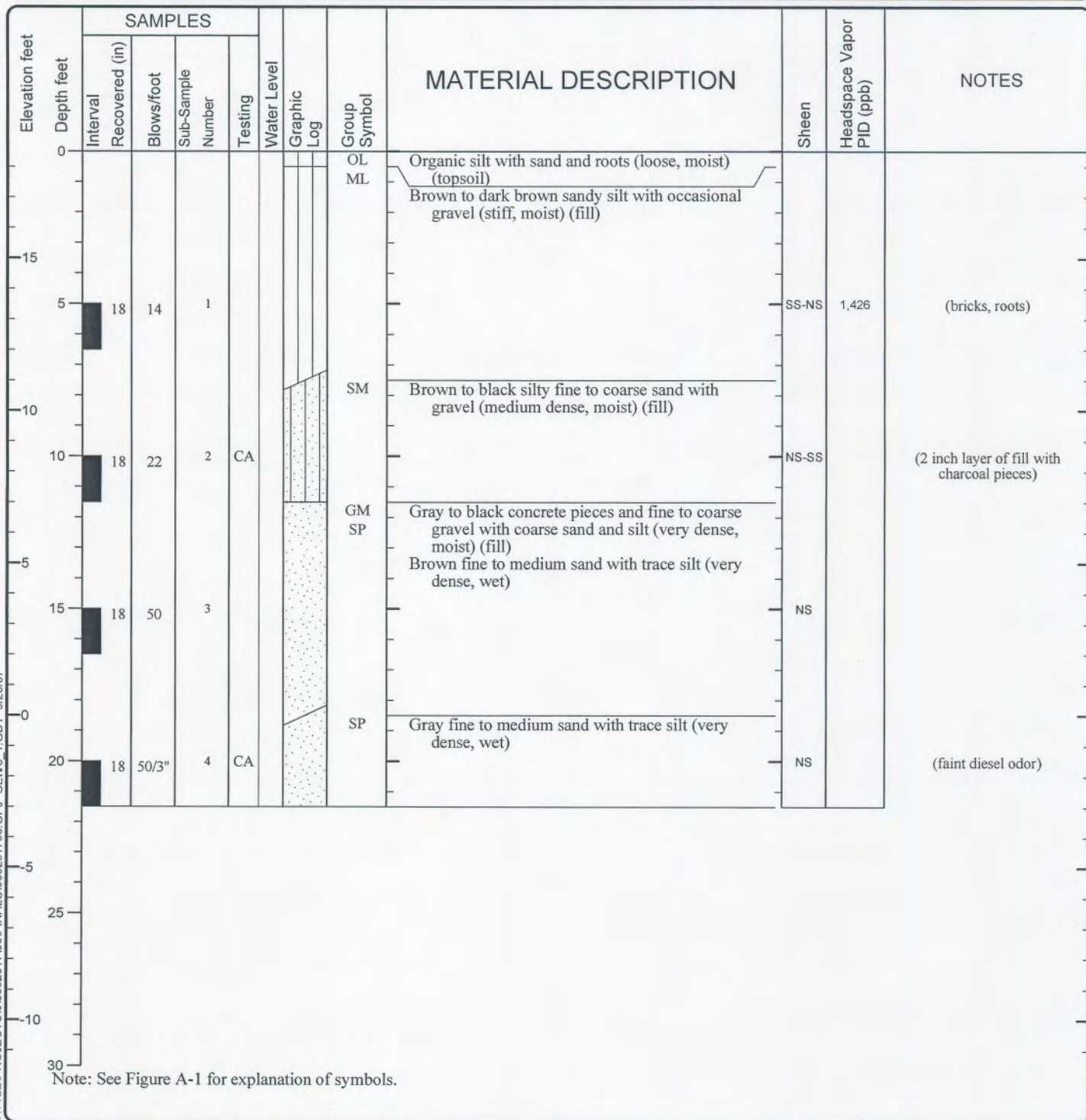
LOG OF MONITORING WELL MW-4 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-5
 Sheet 2 of 2

Date(s) Drilled	05/24/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	21.5	Surface Elevation (ft)	18.51	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	



LOG OF MONITORING WELL MW-5



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-6
 Sheet 1 of 1

Date(s) Drilled	05/22/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	36.5	Surface Elevation (ft)	34.95	Groundwater Elevation (ft)	7.95
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	

Elevation feet	SAMPLES					Water Level Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing						
0							AC	Concrete			
							CR	Crushed rock mixed with treated wood			
							SM	Brown silty fine to medium sand (dense, moist)			
-30	5	18	32	1	CA		ML	Brown sandy silt (very stiff, moist)	NS	>2,000	Creosote-like odor and black tar-like substance
-25	10	18	50	2	CA		SM	Dark brown to black silty fine to medium sand (very dense, moist)	SS-MS	186	Black staining
-20	15	18	50	3			SM	Brown silty fine to medium sand (very dense, moist)	SS-MS	151	Sheen with dark black creosote-like staining
-15	20	18	50	4			ML	Brown to gray interbedded sandy silt with trace gravel (very stiff, moist)	NS-SS	28.0	
-10	25	14	50/4"	5			GM	Light brown fine to coarse gravel with silt and sand (very dense, moist)	NS-SS	108	(diesel odor)
							ML	Brown sandy silt with gravel (hard, moist)			
-5	30						SM	Gray fine to medium silty sand (very dense, wet)			

Note: See Figure A-1 for explanation of symbols.

LOG OF MONITORING WELL MW-6



Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-7
Sheet 1 of 2

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LOG OF MONITORING WELL MW-6 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-7
 Sheet 2 of 2

Date(s) Drilled	05/23/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	36.5	Surface Elevation (ft)	33.24	Groundwater Elevation (ft)	6.24
Vertical Datum		Datum/System	NAVD88	Easting(x): Northing(y):	

Elevation feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
0								AS	Asphalt			
								GM	Dark brown silty fine gravel with sand (loose, moist) (fill)			
30												
5	18	21	1	CA				ML	Brown sandy silt with occasional gravel (stiff, moist)	SS	183	(strong odor-coal pieces throughout)
								SM	Brown silty fine to medium sand with trace gravel (dense, moist)			
25								ML	Brown sandy silt with trace coarse gravel (very stiff, moist) (fill)	NS	15.7	
10	8	27	2									
20								SM	Brown silty fine to medium sand with occasional fine gravel (very dense, moist)	SS	601	
15	18	43	3									
20	18	63	4							SS	1,086	
10								SP-SM	Gray fine to medium sand with silt (very dense, moist)			
25	18	48	5	CA				ML	Brown silt with fine sand (very stiff, moist)	HS	328	(very strong diesel odor)
5								GM	Brown silty well-graded gravel with sand (very dense, wet)			
30												

Note: See Figure A-1 for explanation of symbols.

LOG OF MONITORING WELL MW-7

GEOENGINEERS

Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-8
Sheet 1 of 2

V6_ENVBORING W:\SEATTLE\PROJECTS\089201700\FINALS\089201700.GPJ GEIV6 1.GDT 9/20/07

Elevation feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
30	ND	50/5"		6						NS	50.3	
35	ND	50/6"		7						NS		
0												
5												
10												
15												
20												
25												
30												
35												
40												
45												
50												
55												
60												
65												

LOG OF MONITORING WELL MW-7 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-8
 Sheet 2 of 2

Date(s) Drilled	05/22/07	Logged By	MSL	Checked By	MSL
Drilling Contractor	Cascade Drilling	Drilling Method	HSA	Sampling Methods	Dames & Moore
Auger Data	4 1/4-inch ID	Hammer Data	300 lb hammer/30 in drop	Drilling Equipment	CME 75
Total Depth (ft)	41.5	Surface Elevation (ft)	35.56	Groundwater Elevation (ft)	6.56
Vertical Datum		Datum/ System	NAVD88	Easting(x): Northing(y):	

Elevation feet	SAMPLES					Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor PID (ppb)	NOTES
	Interval	Recovered (in)	Blows/foot	Sub-Sample Number	Testing							
0												
35								OL	Organic top soil (loose, moist)			
								SM	Light brown silty fine to medium sand with gravel (medium dense, moist) (fill)			
5	18	11		1				SM	Dark brown silty fine to medium sand with gravel (medium dense, moist) (fill)	SS	4.0	
10	18	5		2	CA			SM		SS	10.1	(pieces of charcoal)
15	18	16		3				SM		SS	14.7	(pieces of charcoal)
20	18	20		4				SM	Brown silty fine to medium sand with gravel (dense, moist) (fill)	SS	17.6	
25	18	70		5	CA			SM	Brown silty well-graded sand with occasional gravel (very dense, moist)	SS	22.0	
30								ML	Gray to brown mottled silt with fine sand (hard, moist)			
								GM	Gray silty well-graded gravel with fine to coarse sand (very dense, wet)	NS-SS		

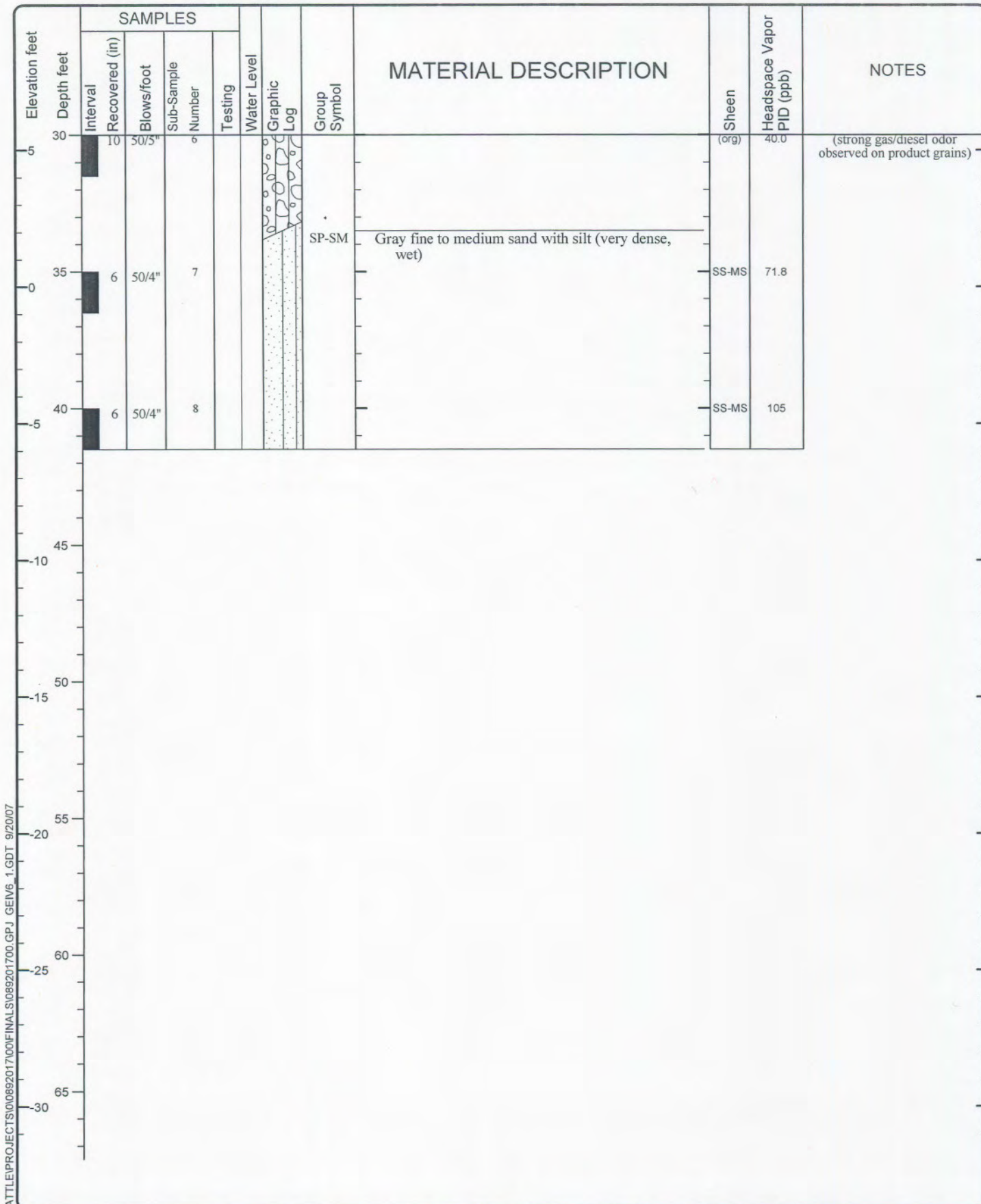
Note: See Figure A-1 for explanation of symbols.

LOG OF MONITORING WELL MW-8

GEOENGINEERS

Project: McConkey/Sesko
Project Location: Bremerton, Washington
Project Number: 0892-017-00

Figure A-9
Sheet 1 of 2



LOG OF MONITORING WELL MW-8 (continued)



Project: McConkey/Sesko
 Project Location: Bremerton, Washington
 Project Number: 0892-017-00

Figure A-9
 Sheet 2 of 2

DRILLING LOG OF WELL/BORING NO. MP-01

Page 1 of 1

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 35

Boring Location: Between welding shop and granite countertop workshop Ground Elevation (feet above N/A): _____

Date Started/Finished: 5/14/2008 - 5/14/2008 Inner Casing Elevation (TOC): _____

Drilling Contractor: Boart Longyear - John Bennett First Encountered: ▽ _____ Final: ▽ _____

Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

										COMMENTS	
										Reviewed By:	
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts		
Ground Surface Elevation				ground surface (gs)							
1	No well installed.			Auger down to 3.5 feet below ground surface (bgs).	0		0.9			Sample MP01SB05 was collected.	
2											
3	Borehole was plugged with hydrated sodium-bentonite chips (3/8-inch).			3.5							Sample MP01SB10 was collected.
4				4.0	Dark brown SAND with concrete fragments from blacktop, dry, no odor.	0		0.5			
5											Sample MP01SB15 was collected.
6				8.5	Light brown fine to medium SAND, some silt, dry, no odor. Auger down to 8.5 feet bgs.	0		1.5			
7											Sample MP01SB20 was collected.
8				13.5	Light brown-grey fine to medium SAND, some large and small gravel, trace silt, dry, no odor. Auger down to 13.5 feet bgs.	0		1.5			
9											Sample MP01SB25 was collected.
10				18.5	Light brown-grey fine to medium SAND, dry, no odor. Auger down to 18.5 feet bgs.	0		1.5			
11											Sample MP01SB30 was collected.
12				23.5	Light brown-grey fine to medium SAND, some coarse grains, trace silt, moist, no odor. Auger down to 23.5 feet bgs.	0		1.5			
13											Sample MP01SB35 was collected.
14				28.5	Grey silty SAND, some small gravel, trace large gravel, moist, no odor. Auger down to 28.5 feet bgs.		1.5				
15											
16				33.5	Light brown-grey CLAY, medium plasticity, dry, no odor.						
17				34.0	Light brown-grey CLAY with reddish brown well graded sand, oxidation present, transitional interval, dry no odor.						
18				35.0	END boring at 35' - no oil material or odor observed						
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
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43											
44											
45											



DRILLING LOG OF WELL/BORING NO. MP-02

Page 1 of 1

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 30
 Boring Location: West of N. McConkey prop near gate Ground Elevation (feet above N/A): _____
 Date Started/Finished: 5/19/2008 - 5/19/2008 Inner Casing Elevation (TOC): _____
 Drilling Contractor: Dave Puckett First Encountered: ▽ _____ Final: ▽ _____
 Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

										COMMENTS
										Reviewed By:
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	
Ground Surface Elevation				ground surface (gs)						
1		No well installed. Borehole was plugged with hydrated sodium-bentonite chips (3/8-inch).		Auger down to 3.5' bgs			1.5		0	Sample MP02SB05 was collected.
2										
3				3.5						
4				4.0	Dark brown fine SAND, some silt, large and small gravel.					
5					Light brown fine SAND, trace small gravel, dry. Blow counts: 2-5-7.		1.5		0	
6					Auger down to 8.5 feet below ground surface.					
7					Light brown/grey fine to medium SAND, some small gravel, trace large gravel, trace silt, dry, no odor. Blow counts: 3-9-13. Auger down to 13.5 feet bgs.		1.5		0	
8					Light brown/grey fine to medium SAND, trace silt, dry, no odor. Blow counts: 7-19-31. Auger down to 18.5 feet bgs.		1.5		0	
9					Light brown/grey fine to medium SAND, trace silt, dry, no odor. Blow counts: 9-12-22. Auger down to 23.5 feet bgs.		1.5		0	
10					Light brown/grey fine to medium SAND, trace silt, dry, no odor. Blow counts: 9-11-14. Auger down to 28.5 feet bgs.		1.5		0	
11					Light brown/grey fine to medium SAND, trace silt, dry, no odor. Blow counts: 8-18-21.		1.5		0	
12					End boring at 30 feet bgs- no water encountered.					
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
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PROJECT NAME: Bremerton Gas Works
WELL NO.: MP-02

WELL_LOG BREMERTON.GPJ 11-25-08

DRILLING LOG OF WELL/BORING NO. MP-03

Page 1 of 1

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 20

Boring Location: West of Thomas Avenue, inside fence Ground Elevation (feet above N/A): _____

Date Started/Finished: 5/19/2008 - 5/19/2008 Inner Casing Elevation (TOC): _____

Drilling Contractor: Dave Puckett First Encountered: ▽ 18 Final: ▼ _____

Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

										COMMENTS		
										Reviewed By:		
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts			
Ground Surface Elevation				ground surface (gs)								
1		No well installed. Borehole was plugged with hydrated sodium-bentonite chips (3/8-inch).		Auger down to 3.5 feet below ground surface (bgs).						Sample MP03SB05 was collected.		
2								1.5			0	
3				3.5								
4							Light brown grey SILT, some clay, some fine sand, dry, trace very small gravel. Auger down to 8.5 feet bgs. FID: 0.0 Blow counts: 5-6-9					Sample MP03SB10 was collected.
5									0		0	
6				8.5								
7												Sample MP03SB20 was collected.
8												
9				Grey/brown SILT with some clay, trace fine sand, trace small gravel, low plasticity, dry FID: 0.0 Blow counts: 10-16-12				1.5		0		
10				10.0								
11												
12												
13									0		0	
14												
15												
16							SILT, no recovery, refusal, unable to salvage a sample for SB15, will continue to 18.5 - 20					
17				16.5								
18								1.5				
19							Light brown/grey sorted fine medium coarse SAND, trace silt, trace gravel, wet, water at 18' bgs FID: 0.0 Blow counts: 5-7-13					
20				20.0								
21							END of boring at 20' bgs					
22												
23												
24												
25												



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PROJECT NAME: Bremerton Gas Works
WELL NO.: MP-03

WELL_LOG BREMERTON.GPJ 11-25-08

DRILLING LOG OF WELL/BORING NO. MP-04

Page 1 of 1

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 40

Boring Location: South of Port Washington Narrows, west of Sesko Ground Elevation (feet above N/A): _____

Prop _____ Inner Casing Elevation (TOC): _____

Date Started/Finished: 5/13/2008 - 5/13/2008 Groundwater Depth (feet BGS): _____

Drilling Contractor: Boart Longyear - John Bennett First Encountered: ▽ 31 Final: ▼ 31.35

Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

									COMMENTS
									Reviewed By:
ELEVATION	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	
DEPTH (feet)									
Ground Surface Elevation	Heavy Gauged Steel Protective Casing		ground surface (gs)						
1	Concrete Cement Base.		SILT. Auger down to 3.5 feet below ground surface (bgs).			1.5		0	Sample MP04SB05 was collected.
2									
3									
4			3.5						
5			4.3	Grey sandy SILT, some small gravel, trace clay, dry.		1.5		0	
6				Light brown fine SAND, some silt, dry, slight odor. Auger down to 8.5 bgs.					Sample MP04SB10 was collected.
7									
8			8.5			1.5		0	
9	Hydrated Sodium-Bentonite Seal with 3/8" Chips.			Light brown fine to medium SAND, some silt, dry, no odor. Auger down to 13.5 bgs.					
10						1.5		0	
11									Sample MP04SB15 was collected.
12			13.5			1.5		0	
13									
14	2.0" ID, Schedule 40, PVC Riser.			Light brown and grey SILT, some sand, dry, no odor. Auger down to 18.5 bgs.					
15						1.5		0	
16			18.5			4		0	Sample MP04SB20 was collected.
17				Light brown fine to medium SAND, trace silt, dry, no odor. Auger down to 23.5 bgs.					
18						4		0	
19									
20									Sample MP04SB25 was collected.
21			23.5			4		0	
22									
23									
24			25.0	GRAVEL. Refusal - no recovery due to a mixture of small and large gravel and cobbles.		4		0	
25			25.8						Sample MP04SB35 was collected.
26			26.5	Reddish brown SILT with some sand and some small and large gravel, dry, no odor.		1		0	
27				light brown-grey CLAY, trace silt, dry, no odor, medium plasticity.					
28				GRAVEL. Refusal - no recovery due to a large amount of cobbles at this interval.		1.5		0	
29			33.5						Sample MP04SB45 was collected.
30	20/40 Mesh Silica Sand Filter Pack 2.0" ID, Schedule 40, PVC Screen (0.010" Slots).					1.5		0	
31									
32			38.5	Grey well graded fine to medium to coarse SAND, trace silt, trace gravel, moist. Auger down to 40 feet bgs.					
33			40.0						
34				Grey well graded fine to medium to coarse SAND, trace silt, trace clay, saturated, no odor					
35				END boring at 40 feet bgs.					
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									



DRILLING LOG OF WELL/BORING NO. SP-01

Page 1 of 2

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 20


Boring Location: West of Pennsylvania Avenue, southeast of MW-04 Ground Elevation (feet above N/A): _____

Date Started/Finished: 5/12/2008 - 5/12/2008 Inner Casing Elevation (TOC): _____

Drilling Contractor: Boart Longyear - John Bennett Groundwater Depth (feet BGS): _____

Drill Method: Hollow Stem Auger/1.5' splitspoon First Encountered: ▽ 17 Final: ▽ _____

Geologist: Courtney Funk

										COMMENTS
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	Reviewed By:
Ground Surface Elevation				ground surface (gs)						
		No well installed. Borehole was plugged with hydrated sodium-bentonite chips (3/8-inch).		SAND. Auger down to 3.5 feet below ground surface (bgs).			1.5			Sample SP01SB05 was collected.
1										
2										
3										
4				3.5						
5				3.8	Light brown and grey well graded SAND, dry, no odor present.					
6				4.5	Light brown and grey very fine to fine SAND, some silt, trace gravel (small), dry. FID: 0.0, Blow counts:3-9-13.					
7					Light brown/grey CLAY medium plasticity, dry. Auger down to 8.5 feet bgs.		0			
8										
9				8.5						
10				9.0	Light brown/grey CLAY with predominant red brown sand lenses with oxidation present, trace silt, medium plasticity, dry. FID: 0.0, Blow counts:9-13-15.					
11					Light brown/grey well graded SAND, dry. Auger down to 13.5 feet bgs.		1.5			
12										



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PROJECT NAME: Bremerton Gas Works
WELL NO.: SP-01

WELL_LOG BREMERTON.GPJ 11-25-08

DRILLING LOG OF WELL/BORING NO. SP-01

Page 2 of 2

Project/Location: Bremerton Gas Works / Bremerton, WA

Total Depth of Hole (feet BGS): 20

ELEVATION DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	COMMENTS
									Reviewed By:
13			13.5						Sample SP01SB15 was collected.
14			14.3			1.5			
15			Light brown/grey CLAY with predominant reddish brown sand lenses (fine - medium), trace gravel, wet, low plasticity and oxidation present. FID: 0.0, Blow counts:19-49-57. Auger down to 18.5 feet bgs.						Sample SP01SB20 was collected.
16									
17			18.5			1.5			
18			19.3						
19			20.0						
20			Light brown/grey CLAY, trace sand, wet, medium plasticity, cohesive. FID: 0.0, Blow counts:23-29-47. End of boring at 20 feet bgs, no water encountered						
21									
22									
23									
24									
25									
26									
27									
28									



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PROJECT NAME: Bremerton Gas Works
WELL NO.: SP-01

WELL_LOG BREMERTON.GPJ 11-25-08

DRILLING LOG OF WELL/BORING NO. SP-02

Page 1 of 1

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 35

Boring Location: West of Pennsylvania Avenue, northeast of MW-04 Ground Elevation (feet above N/A): _____

Date Started/Finished: 5/12/2008 - 5/12/2008 Inner Casing Elevation (TOC): _____

Drilling Contractor: Boart Longyear - John Bennett First Encountered: ▽ 28.5 Final: ▽ 29.3

Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

									COMMENTS	
									Reviewed By:	
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	
Ground Surface Elevation		Heavy Gauged Steel Protective Casing		ground surface (gs)						
1	1	Concrete Cement Base.		Light brown very fine to fine SAND, some silt, some gravel, root material present, dry. FID:0.0, Blow counts:1-1-1. Auger down to 10 feet below ground surface (bgs).			1.5		0	
2	2							1.5		0
3	3									
4	4									
5	5									
6	6									
7	7									
8	8	Hydrated Sodium-Bentonite Seal with 3/8" Chips.		10.0			1.5		0	
9	9									
10	10									
11	11			12.5	Light brown-grey SILT, some sand, some clay, trace gravel, trace brick fragments, dry. FID:0.0, Blow counts:8-11-14.		1.5		0	
12	12									
13	13									
14	14			14.0	Light brown-grey SILT, some sand, some clay, dry. FID:0.0, Blow counts:5-8-19. Auger down to 18.5 feet bgs.		1.5		0	
15	15									
16	16	2.0" ID, Schedule 40, PVC Riser.								
17	17									
18	18			19.0	Light brown-grey SILT, some sand, some clay, dry.		1.5		0	
19	19									
20	20									
21	21									
22	22									
23	23			23.5	Grey CLAY, trace silt, dry, medium plasticity. FID:0.0, Blow counts:8-13-50. Auger down to 23.5 feet bgs.		1.5		0	
24	24									
25	25									
26	26	20/40 Mesh Silica Sand Filter Pack								
27	27									
28	28			28.5	Grey medium to fine SAND, wet, trace brick fragments. FID:0.0, Blow counts:25-44-54. Auger down to 28.5 feet bgs.		1.5		0	
29	29									
30	30									
31	31									
32	32									
33	33						0		0	
34	34	2.0" ID, Schedule 40, PVC Screen (0.010" Slots).		35.0	Grey medium to fine SAND, wet, no odor, water encountered at 28.5 feet bgs. FID:0.0, Blow counts:23-55. Auger to 35 feet bgs for well installation. no oil material or odors observed.					
35	35									
36	36							0		0
37	37									
38	38									
39	39									
40	40									
41	41									
42	42									
43	43									
44	44									
45	45									



DRILLING LOG OF WELL/BORING NO. SP-03

Page 1 of 2

Project/Location: Bremerton Gas Works / Bremerton, WA Total Depth of Hole (feet BGS): 45

Boring Location: South of Port Washington Narrows, east of N Ground Elevation (feet above N/A): _____

McConkey Prop _____ Inner Casing Elevation (TOC): _____

Date Started/Finished: 5/12/2008 - 5/12/2008 Groundwater Depth (feet BGS): _____

Drilling Contractor: Boart Longyear - John Bennett First Encountered: ▽ 41 Final: ▽ _____

Drill Method: Hollow Stem Auger/1.5' splitspoon Geologist: Courtney Funk

										COMMENTS
										Reviewed By:
ELEVATION	DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	
Ground Surface Elevation				ground surface (gs)						
1		No well installed. Borehole was plugged with hydrated sodium-bentonite chips (3/8-inch).		Light brown-grey very fine to fine SAND, some silt, root material, some small gravel, dry.					0	Sample SP03SB05 was collected.
2										
3										
4				4.3						
5				5.0	Black coated SAND, coal fragments, oil materials, slight odor, dry. FID:138, Blow counts:5-3-2.					
6					Black coated SAND, coal fragments, oil materials, slight odor. FID:25, Blow counts: 50 for 50.		0.9		0	Sample SP03SB10 was collected.
7				8.0	Black coated fine to medium SAND, some silt, wood fragments, coal fragments, large gravel, ash material, trace brick, staured with oil material, moderate to strong odor. PID:348 ppm, FID:308, blow counts:2-2-2. Auger down to 13.5 feet below ground surface (bgs).					
8										
9							0.5		0	
10										
11										
12										
13				13.5						Sample SP03SB15 was collected.
14				14.0	Grey very fine to fine SAND, some silt, moist, no visual oil material, slight odor.				0	
15					Grey CLAY with reddish brown sand lenses throughout, oxidation present, dry, moderate plasticity. FID:36, blow counts:6-6-6. Auger down to 18.5 feet bgs					
16							1.5		0	
17				18.5						
18				19.0	Light brown-grey SILT, some clay, trace silt					Sample SP03SB20 was collected.
19				19.5	Grey CLAY with reddish brown sand lenses, dry, medium plasticity. Light brown-grey SILT, some clay, trace sand. FID:0, blow counts:12-16-23. Auger down to 23.5 feet bgs.					
20										
21									0	
22										
23				23.5						Sample SP03SB25 was collected.
24					Grey CLAY, some silt, dry, medium					
25										

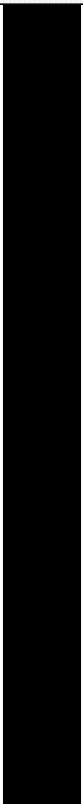

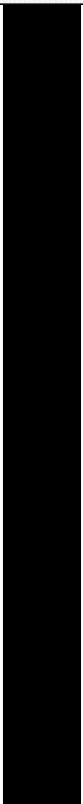



DRILLING LOG OF WELL/BORING NO. SP-03

Page 2 of 2

Project/Location: Bremerton Gas Works / Bremerton, WA

Total Depth of Hole (feet BGS): 45

ELEVATION DEPTH (feet)	WELL COMPLETION DIAGRAM	GRAPHIC LOG	SOIL/ROCK DESCRIPTION	SAMPLE INTERVAL	PID Readings (PPM)	RECOVERY (feet)	LEL (%)	Blow Counts	COMMENTS
									Reviewed By:
26			plasticity, slight odor. FID:11 ppm. Auger down to 28.5 feet bgs.			1.5		0	Sample SP03SB30 was collected.
27									
28			28.5						
29			Grey CLAY, some silt, dry, medium plasticity. Auger down 33.5 feet bgs. FID:0, blow counts:9-14-18.			1.5		0	
30									
31									Sample SP03SB35 was collected.
32									
33			33.5						
34			Grey CLAY, some silt, dry, medium plasticity, no odor. Auger down 38.5 feet bgs. FID:0, blow counts:9-17-24.			1.5		0	Sample SP03SB40 was collected.
35									
36									
37									Sample SP03SB45 was collected.
38			38.5			1.5			
39			39.3 Grey CLAY with some sand, some silt, dry, med/low plasticity Grey CLAY, some silt, dry, medium plasticity. Auger down 43.5 feet bgs.						
40									Sample SP03SB45 was collected.
41									
42									
43			43.5						
44			45.0 Dark grey SAND, well graded, wet slight odor, very slight staining. FID:0, Blow counts:23-50-5. --- / END boring at 45 feet bgs.						
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									



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PROJECT NAME: Bremerton Gas Works
WELL NO.: SP-03

WELL_LOG BREMERTON.GPJ 11-25-08

FORMER SC FUELS BORING LOGS

LOG OF EXPLORATORY BORING

PROJECT NAME **Tosco**
 LOCATION **Former Bremerton Bulk Plant No. 1783**
 DRILLED BY **Cascade Drilling, Inc.**
 DRILL METHOD **Hollow Stem Auger**
 LOGGED BY **Mike Noll**

BORING NO. **SC-MW-1**
 PAGE **1 OF 2**
 GROUND ELEV. **89.55'**
 TOTAL DEPTH **13.00'**
 DATE COMPLETED **2/12/99**

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-1	190	17-20-23	2/17/99	5				<p>0 to 0.3 foot: ASPHALT (AS)</p> <p>0.3 to 5.0 feet: SANDY SILT WITH GRAVEL (ML), brown, becoming olive gray at 2.0 feet, 80 percent low plasticity fines, 10 to 15 percent fine sand, 5 percent fine subrounded gravel, firm to stiff, moist. Some petroleum-like odor.</p>
SB-2	307	10-12-12						<p>5.0 to 6.0 feet: SILTY SAND (SM), with SANDY SILT (ML), olive gray, 40 to 60 percent fine sand, 40 to 60 percent low plasticity fines, dense/stiff, moist. Some petroleum-like odor.</p>
SB-3	479	22-26-30						<p>6.0 to 7.0 feet: CLAYEY SILT (MH), olive to olive gray, some yellow and brown mottling, 95 to 100 percent medium plasticity fines, firm to stiff, moist. Strong petroleum-like odor.</p>
SB-4	27	12-14-15						<p>7.0 to 9.5 feet: SANDY SILT (ML) and SILTY SAND (SM), tan to olive brown, grading to olive gray, 40 to 60 percent fine sand, 40 to 60 percent low plasticity fines, stiff/dense, moist. Strong petroleum-like odor.</p>
SB-5	25	16-22-25	ATD	10				<p>9.5 to 13.0 feet: SILT (ML), tan to olive brown becoming gray at 12.0 feet, 95 to 100 percent nonplastic to low plasticity fines, trace fine sand, stiff to very stiff, moist, becoming dry below 12.0 feet. Sheen on sample barrel at 10 to 11.5 feet. No odor below 12.0 feet.</p>
SB-6	39	18-25-32		15				<p>Bottom of boring at 13.0 feet.</p>
				20				See Page 2 for Well Completion Details.

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

99-02-008.TSCOB.sa:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
 LOCATION Former Bremerton Bulk Plant No. 1783
 DRILLED BY Cascade Drilling, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SC-MW-1
 PAGE 2 OF 2
 GROUND ELEV. 89.55'
 TOTAL DEPTH 13.00'
 DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				25				WELL COMPLETION DETAILS: 0.2 to 3.0 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC blank casing. 3.0 to 13.0 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC well screen with 0.010-inch machined slots. 13.0 to 13.2 feet: 2-inch-diameter, Schedule 40, PVC threaded end-cap. 0 to 1.0 foot: concrete. 1.0 to 2.5 feet: bentonite chips hydrated with potable water. 2.5 to 13.0 feet: 20-40 Colorado silica sand.
				30				
				35				
				40				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
LOCATION Former Bremerton Bulk Plant No. 1783
DRILLED BY Cascade Drilling, Inc.
DRILL METHOD Hollow Stem Auger
LOGGED BY Mike Noll

BORING NO. SB-2
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 22.00'
DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 8 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-1	2.5	10-30-30		5				0 to 5.0 feet: GRAVELLY SILT (ML), and SANDY SILT (ML), olive to olive brown, 80 to 90 percent low plasticity fines, 5 to 10 percent fine to medium sand, 10 to 15 percent fine to medium subrounded gravel, stiff, moist to wet. No odor.
SB-2	1.5	6-4-16						5.0 to 14.0 feet: SANDY SILT (ML), with thin SILTY SAND (SM) interbeds, olive gray, becoming tan to olive brown with some yellowish mottling below 9.5 feet, 90 to 95 percent low plasticity fines, 5 to 10 percent fine sand, 10 percent fine subangular gravel at 6.0 to 8.0 feet, stiff to very stiff, dry to moist. No odor.
SB-3	2.5	5-10-12						
SB-4	50	12-15-25						
SB-5	8	50-50/3"		10				
SB-6	4.5	50-50/3"						
SB-7	--	45-50/3"						
SB-8	10	40-50/6"		15				14.0 to 22.0 feet: SILT (ML), gray to olive gray, 95 to 100 percent nonplastic to low plasticity fines, trace fine sand, stiff to very stiff, dry to moist. Some laminations and fine beds below 17.0 feet. Faint petroleum-like odor at 18.0 feet.
SB-9	2	40-50/5"						
SB-10	1.5	40-50						
SB-11	6.5	55/6"		20				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

89-02-009.TSCOB.sa:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
 LOCATION Former Bremerton Bulk Plant No. 1783
 DRILLED BY Cascade Drilling, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SB-2
 PAGE 2 OF 2
 GROUND ELEV.
 TOTAL DEPTH 22.00'
 DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-12	4.5	65/4"						14.0 to 22.0 feet: SILT (ML), continued.
								Bottom of boring at 22.0 feet.
								Boring backfilled with bentonite chips hydrated with potable water.
				25				
				30				
				35				
				40				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

99-02-009.TSCOB.sa:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME **Tosco**
 LOCATION **Former Bremerton Bulk Plant No. 1783**
 DRILLED BY **Cascade Drilling, Inc.**
 DRILL METHOD **Hollow Stem Auger**
 LOGGED BY **Mike Noll**

BORING NO. **SB-3**
 PAGE **1 OF 2**
 GROUND ELEV.
 TOTAL DEPTH **20.50'**
 DATE COMPLETED **2/12/99**

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-1	2	17-23-25		5				0 to 5.5 feet: SANDY SILT (ML) , tan to olive brown, 95 percent low plasticity fines, 5 percent fine sand, firm, moist. No odor.
SB-2	5.5	30-32-36						5.5 to 8.0 feet: SILTY SAND (SM) and SANDY SILT (ML) , interbeds, olive to olive gray, 50 to 60 percent fine sand, 40 to 50 percent low plasticity fines, medium dense to dense, moist. No odor.
SB-3	4	36-40-45						8.0 to 15.5 feet: SANDY SILT (ML) , olive to olive brown with some brown and yellowish brown mottling, 95 percent nonplastic to low plasticity fines, 5 percent fine sand, stiff to very stiff, dry to moist. No odor.
SB-4	4	40-42-48		10				
SB-5	2.5	40-35-49						
SB-6	5	38-50/6"						
SB-7	8.1	42-50/6"						
SB-8	16	50/5"		15				
SB-9	4	50-50/5"						15.5 to 16.5 feet: SILTY SAND (SM) , gray, 50 percent fine sand, 50 percent nonplastic to low plasticity fines, very dense, moist. Faint petroleum-like odor.
SB-10	11	50-50/5"						16.5 to 20.5 feet: SILT (ML) , gray, 95 to 100 percent nonplastic fines, trace to 5 percent fine sand, stiff to very stiff, dry. No odor.
SB-11	2	50-50/4"		20				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photolonization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
 LOCATION Former Bremerton Bulk Plant No. 1783
 DRILLED BY Cascade Drilling, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SB-3
 PAGE 2 OF 2
 GROUND ELEV.
 TOTAL DEPTH 20.50'
 DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				25				16.5 to 20.5 feet: SILT (ML), continued. Bottom of boring at 20.5 feet. Boring backfilled with bentonite chips hydrated with potable water.
				30				
				35				
				40				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photolonization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

99-02-009.TSCOB.sa:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
 LOCATION Former Bremerton Bulk Plant No. 1783
 DRILLED BY Cascade Drilling, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SC-MW-4
 PAGE 1 OF 2
 GROUND ELEV. 94.73'
 TOTAL DEPTH 15.50'
 DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-1	288	47-55	2/19/99	5				0 to 0.5 foot: SILTY GRAVEL (GM) , olive gray, 75 to 80 percent fine to medium subangular gravel (crushed rock), 5 to 10 percent fine to coarse sand, 10 to 20 percent low plasticity fines, medium dense, moist. (FILL)
SB-2	655	50-65						0.5 to 9.0 feet: SANDY SILT (ML) , olive to olive gray, some yellowish mottling below 8.0 feet, 85 to 95 percent nonplastic to low plasticity fines, 5 to 15 percent fine sand, stiff, dry to moist. Strong petroleum-like odor.
SB-3	666	50-60						
SB-4	665	50-60						
SB-5	38	35-50	10					9.0 to 11.0 feet: SILTY SAND (SM) and SANDY SILT (ML) interbeds, olive to olive gray, 60 percent fine sand, 40 percent low plasticity fines, dense, moist. Some petroleum-like odor.
SB-6	30	42-50/5"	ATD					11.0 to 15.5 feet: SANDY SILT (ML) , olive gray to gray, 90 to 95 percent low plasticity fines, 5 to 10 percent fine sand, stiff, wet. Faint petroleum-like odor.
SB-7	78	50/50/4"		15				Bottom of boring at 15.5 feet.
				20				See Page 2 for Well Completion Details.

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photolonization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

99-02-009.TSCOB.en:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME **Tosco**
 LOCATION **Former Bremerton Bulk Plant No. 1783**
 DRILLED BY **Cascade Drilling, Inc.**
 DRILL METHOD **Hollow Stem Auger**
 LOGGED BY **Mike Noll**

BORING NO. **SC-MW-4**
 PAGE **2 OF 2**
 GROUND ELEV. **94.73'**
 TOTAL DEPTH **15.50'**
 DATE COMPLETED **2/12/99**

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				25				WELL COMPLETION DETAILS: 0.2 to 5.2 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC blank casing. 5.2 to 15.2 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC well screen with 0.010-inch machined slots. 15.2 to 15.4 feet: 2-inch-diameter, Schedule 40, PVC threaded end-cap. 0 to 1.0 foot: concrete. 1.0 to 4.0 feet: bentonite chips hydrated with potable water. 4.0 to 15.5 feet: 20-40 Colorado silica sand.
				30				
				35				
				40				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco
 LOCATION Former Bremerton Bulk Plant No. 1783
 DRILLED BY Cascade Drilling, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SC-MW-5
 PAGE 1 OF 2
 GROUND ELEV. 94.92'
 TOTAL DEPTH 16.00'
 DATE COMPLETED 2/12/99

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
SB-1	0.5	70/6"		5				0 to 5.5 feet: SANDY SILT (ML) , olive gray, 85 to 90 percent low plasticity fines, 10 to 15 percent fine sand, trace to 5 percent fine to medium subrounded gravel, stiff, moist. No odor.
SB-2	0	100/6"						5.5 to 11.5 feet: SILTY SAND (SM) and SANDY SILT (ML) interbeds, olive gray to olive brown, some yellowish brown mottling from 6.5 to 11.0 feet, 50 percent fine sand, 50 percent low plasticity fines, dense, moist. No odor.
SB-3	0	50-50/5"						
SB-4	0	60-50/3"	2/17/99					
SB-5	0.5	50-50/5"		10				
SB-6	1	55-50/5"						11.5 to 12.0 feet: SAND (SP) , gray, 75 percent fine to medium sand, 5 percent fine subrounded gravel, 5 to 10 percent low plasticity fines, medium dense, wet. No odor.
SB-7	0.5	50-50/5"						12.0 to 16.0 feet: SANDY SILT (ML) and some SILTY SAND (SM) interbeds, gray, 80 to 95 percent nonplastic to low plasticity fines, 5 to 20 percent fine sand, stiff to very stiff, moist. No odor.
SB-8		50-50		15				
				20				Bottom of boring at 16.0 feet.
								See Page 2 for Well Completion Details.

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

99-02-009.TSC0B.SB:1.03/11/99...TSC0B

LOG OF EXPLORATORY BORING

PROJECT NAME **Tosco**
 LOCATION **Former Bremerton Bulk Plant No. 1783**
 DRILLED BY **Cascade Drilling, Inc.**
 DRILL METHOD **Hollow Stem Auger**
 LOGGED BY **Mike Noll**

BORING NO. **SC-MW-5**
 PAGE **2 OF 2**
 GROUND ELEV. **94.92'**
 TOTAL DEPTH **16.00'**
 DATE COMPLETED **2/12/99**

SAMPLE METHOD AND NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				25				WELL COMPLETION DETAILS: 0.2 to 5.2 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC blank casing. 5.2 to 15.2 feet: 2-inch-diameter, flush-threaded, Schedule 40, PVC well screen with 0.010-inch machined slots. 15.2 to 15.4 feet: 2-inch-diameter, Schedule 40, PVC threaded end-cap. 0 to 1.0 foot: concrete. 1.0 to 4.0 feet: bentonite chips hydrated with potable water. 4.0 to 16.0 feet: 20-40 Colorado silica sand.
				30				
				35				
				40				

REMARKS

(1) Upper 4.0 feet of boring excavated by hand. (2) SB = Soil samples collected continuously, using 2-inch O.D. split barrel sampler driven with a 200-pound hammer dropped 30-inches. (3) PID = OVM 580B photoionization detector, calibrated to 100 parts per million (ppm) isobutylene. (4) ATD = At Time of Drilling.

NOLL ENVIRONMENTAL, INC.

B9-02-009.TSCOB.sa:1.03/11/99...TSCOB

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco/Former Bremerton Bulk Plant #1783
 LOCATION Bremerton, Washington
 DRILLED BY GeoTech Explorations, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SC-MW-6
 PAGE 1 OF 1
 TOC ELEV. 89.69'
 TOTAL DEPTH 15.50'
 DATE COMPLETED 3/31/00

SAMPLE NUMBER	PID (ppm)	BLOWS PER 8 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
MW6-5.5	0.7	6-7-9 (K)	4/4/00	5				0 to 0.2 foot: ASPHALT (AS) 0.2 to 0.5 foot: SILTY GRAVEL (GM), brown, 70 percent fine to medium angular gravel (crushed rock), 30 percent low plasticity fines, medium dense, moist. No odor.
MW6-10	0	7-8-10 (A)	ATD	10				0.5 to 7.0 feet: SANDY SILT WITH GRAVEL (ML), olive gray to gray, some blueish gray staining, 60 to 70 percent low plasticity fines, 20 to 40 percent fine and some medium to coarse sand, 5 to 15 percent fine to medium subrounded gravel, stiff to moderately stiff, moist. Some petroleum-like odor and staining. 7.0 to 13.0 feet: SILT WITH SAND (ML), olive to olive gray, some yellowish orange mottling, 95 percent nonplastic to low plasticity fines, 5 percent fine sand, stiff, moist. No odor.
MW6-15	-	18		15				13.0 to 15.5 feet: SILTY GRAVEL WITH SAND (GM), olive to olive gray, 75 to 80 percent fine to medium and some coarse subangular to subrounded gravel, 15 to 20 percent low plasticity fines, 5 to 10 percent fine to coarse sand, dense, wet. (GLACIAL DRIFT) No odor.
				20				Total depth drilled = 15.5 feet. Total depth sampled = 15.5 feet.
				25				WELL COMPLETION DETAILS 0 to 5.0 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC blank casing. 5.0 to 15.0 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots. 15.0 to 15.5 feet: 2-inch diameter, flush-threaded, Schedule 40 tapered PVC endcap.
				30				0 to 1.0 foot: concrete. 1.0 to 3.5 feet: bentonite chips hydrated with potable water. 3.5 to 15.5 feet: 10-20 Colorado silica sand.

REMARKS

- (1) Soil samples collected using a 2-inch O.D. split spoon sampler driven using a 140-pound hammer dropped 30 inches.
 (2) PID = photoionization detector, calibrated to 100 parts per million isobutylene. (3) ATD = At Time of Drilling. (4) TOC = Top of PVC casing. (5) - = Not measured (insufficient sample volume).

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco/Former Bremerton Bulk Plant #1783
 LOCATION Bremerton, Washington
 DRILLED BY GeoTech Explorations, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. **SC-MW-7**
 PAGE 1 OF 1
 TOC ELEV. 90.52'
 TOTAL DEPTH 16.00'
 DATE COMPLETED 3/31/00

SAMPLE NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
MW7-5.5	0.7	2-5-10 <i>MD</i>	4/4/00	5				0 to 0.5 foot: SILTY GRAVEL (GM) , brown, 80 to 85 percent fine to medium and some coarse angular gravel (crushed rock), 5 to 10 percent fine to coarse sand, 10 to 15 percent nonplastic fines, medium dense, dry to moist. No odor.
MW7-10	0.7	3-8-7 <i>MD</i>		10				0.5 to 4.0 feet: SILT WITH GRAVEL (ML) , olive, some yellowish mottling, 80 to 90 percent low plasticity fines, 5 to 10 percent fine to medium and some coarse sand, 5 to 10 percent fine to medium subrounded gravel, stiff, dry to moist. No odor. <i>glacial?</i>
MW7-15	--	6-7 <i>MD</i>		15				4.0 to 14.5 feet: SILT WITH SAND (ML) , olive, some yellowish to yellowish orange mottling, 80 to 90 percent nonplastic fines, 10 to 20 percent fine sand, trace to 5 percent fine to medium subangular to subrounded gravel, stiff, dry to moist, some organics at 5 to 7 feet, some thin lenses of fine sand at 10 to 11 feet. No odor. <i>Open?</i>
				20				14.5 to 16.0 feet: SILT (ML) , gray, 95 to 100 percent nonplastic fines, trace to 5 percent fine sand, stiff to very stiff, dry, some thin sandy laminations. <i>Open?</i>
				25				Total depth drilled = 16.0 feet. Total depth sampled = 16.0 feet.
				30				WELL COMPLETION DETAILS 0 to 4.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC blank casing. 4.7 to 14.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots. 14.7 to 15.2 feet: 2-inch diameter, flush-threaded, Schedule 40 tapered PVC endcap. 0 to 1.0 foot: concrete. 1.0 to 3.5 feet: bentonite chips hydrated with potable water. 3.5 to 16.0 feet: 10-20 Colorado silica sand.

REMARKS

- (1) Soil samples collected using a 2-inch O.D. split spoon sampler driven using a 140-pound hammer dropped 30 inches.
 (2) PID = photoionization detector, calibrated to 100 parts per million isobutylene. (3) TOC = Top of PVC casing. (4) -- = Not measured (insufficient sample volume).

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco/Former Bremerton Bulk Plant #1783
 LOCATION Bremerton, Washington
 DRILLED BY GeoTech Explorations, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. **SC** MW-8
 PAGE 1 OF 2
 TOC ELEV. 92.22'
 TOTAL DEPTH 16.50'
 DATE COMPLETED 3/30/00

SAMPLE NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
MW8-2.5	6.4	GRAB						0 to 2.0 feet: SILTY GRAVEL (GM) , olive brown to brown, 75 percent fine to medium angular gravel (crushed rock), some subrounded gravel, 20 to 25 percent low plasticity fines, trace to 5 percent fine to coarse sand, medium dense, moist. No odor.
NS	-	20-50-47		5				2.0 to 3.0 feet: SILT AND CLAYEY SILT (ML) , tan, becoming gray with yellowish brown mottling, 80 to 85 percent medium plasticity fines, 5 to 10 percent fine to coarse sand, 5 to 10 percent fine to medium subrounded gravel, stiff, moist. Petroleum-like odor from 2.5 to 3 feet.
MW8-7.5	0.7	7-9-12 mD	ATD 4/4/00	10				3.0 to 3.5 feet: SILTY SAND (SM) , gray, 70 percent fine sand, 20 to 25 percent low plasticity fines, 5 to 10 percent fine to medium subrounded gravel, medium dense, moist. Some petroleum-like odor.
MW8-10	0	13-13-15 mD		15				3.5 to 4.5 feet: SILTY GRAVEL (GM) , gray, 60 to 65 percent fine to medium subrounded gravel, 20 to 30 percent low plasticity fines, 5 to 10 percent fine to coarse sand, dense, moist. Faint petroleum-like odor.
MW8-15	0	8-9-12 mD		20				4.5 to 6.5 feet: GRAVELLY SILT (ML) , gray to olive, 80 to 85 percent low plasticity fines, 15 to 20 percent fine to medium subrounded gravel, 5 to 10 percent fine to medium sand, stiff, moist to wet. Faint petroleum-like odor.
				25				6.5 to 8.0 feet: SILTY SAND WITH GRAVEL (SM) , olive, 50 to 60 percent fine to medium and some coarse sand, 30 to 40 percent low plasticity fines, 5 to 10 percent fine to medium subrounded gravel, dense, moist to wet. No odor.
				30				8.0 to 9.5 feet: GRAVELLY SILT WITH SAND (ML) , olive to tan, 90 percent low plasticity fines, 5 to 10 percent fine to medium subrounded gravel, trace sand, stiff, moist. No odor.
								9.5 to 16.5 feet: SILT WITH SAND (ML) , olive to gray, some yellowish mottling, 95 percent low plasticity to nonplastic fines, trace to 5 percent

REMARKS

(1) Soil samples collected using a 2-inch O.D. split spoon sampler driven using a 140-pound hammer dropped 30 inches.
 (2) PID = photoionization detector, calibrated to 100 parts per million Isobutylene. (3) ATD = At Time of Drilling. (4) TOC = Top of PVC casing. (5) - = Not measured (insufficient sample volume). (6) NS = No sample recovered. (7) GRAB = Grab soil sample collected from hand auger bucket.

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME Tosco/Former Bremerton Bulk Plant #1783
 LOCATION Bremerton, Washington
 DRILLED BY GeoTech Explorations, Inc.
 DRILL METHOD Hollow Stem Auger
 LOGGED BY Mike Noll

BORING NO. SC- MW-8
 PAGE 2 OF 2
 TOC ELEV. 92.22'
 TOTAL DEPTH 16.50'
 DATE COMPLETED 3/30/00

SAMPLE NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				35				<p>sand, stiff, dry to moist, some thin laminations at 14 to 16.5 feet. No odor.</p> <p>Total depth drilled = 16.5 feet. Total depth sampled = 16.5 feet.</p> <p>WELL COMPLETION DETAILS 0 to 4.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC blank casing. 4.7 to 14.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots. 14.7 to 15.2 feet: 2-inch diameter, flush-threaded, Schedule 40 tapered PVC endcap.</p> <p>0 to 1.0 foot: concrete. 1.0 to 3.5 feet: bentonite chips hydrated with potable water. 3.5 to 16.5 feet: 10-20 Colorado silica sand.</p>
				40				
				45				
				50				
				55				
				60				

REMARKS

(1) Soil samples collected using a 2-inch O.D. split spoon sampler driven using a 140-pound hammer dropped 30 inches.
 (2) PID = photolionization detector, calibrated to 100 parts per million Isobutylene. (3) ATD = At Time of Drilling. (4) TOC = Top of PVC casing. (5) -- = Not measured (insufficient sample volume). (6) NS = No sample recovered. (7) GRAB = Grab soil sample collected from hand auger bucket.

NOLL ENVIRONMENTAL, INC.

LOG OF EXPLORATORY BORING

PROJECT NAME **Tosco/Former Bremerton Bulk Plant #1783**
 LOCATION **Bremerton, Washington**
 DRILLED BY **GeoTech Explorations, Inc.**
 DRILL METHOD **Hollow Stem Auger**
 LOGGED BY **Mike Noll**

BORING NO. **SC- MW-9**
 PAGE **1 OF 1**
 TOC ELEV. **95.55'**
 TOTAL DEPTH **15.50'**
 DATE COMPLETED **3/30/00**

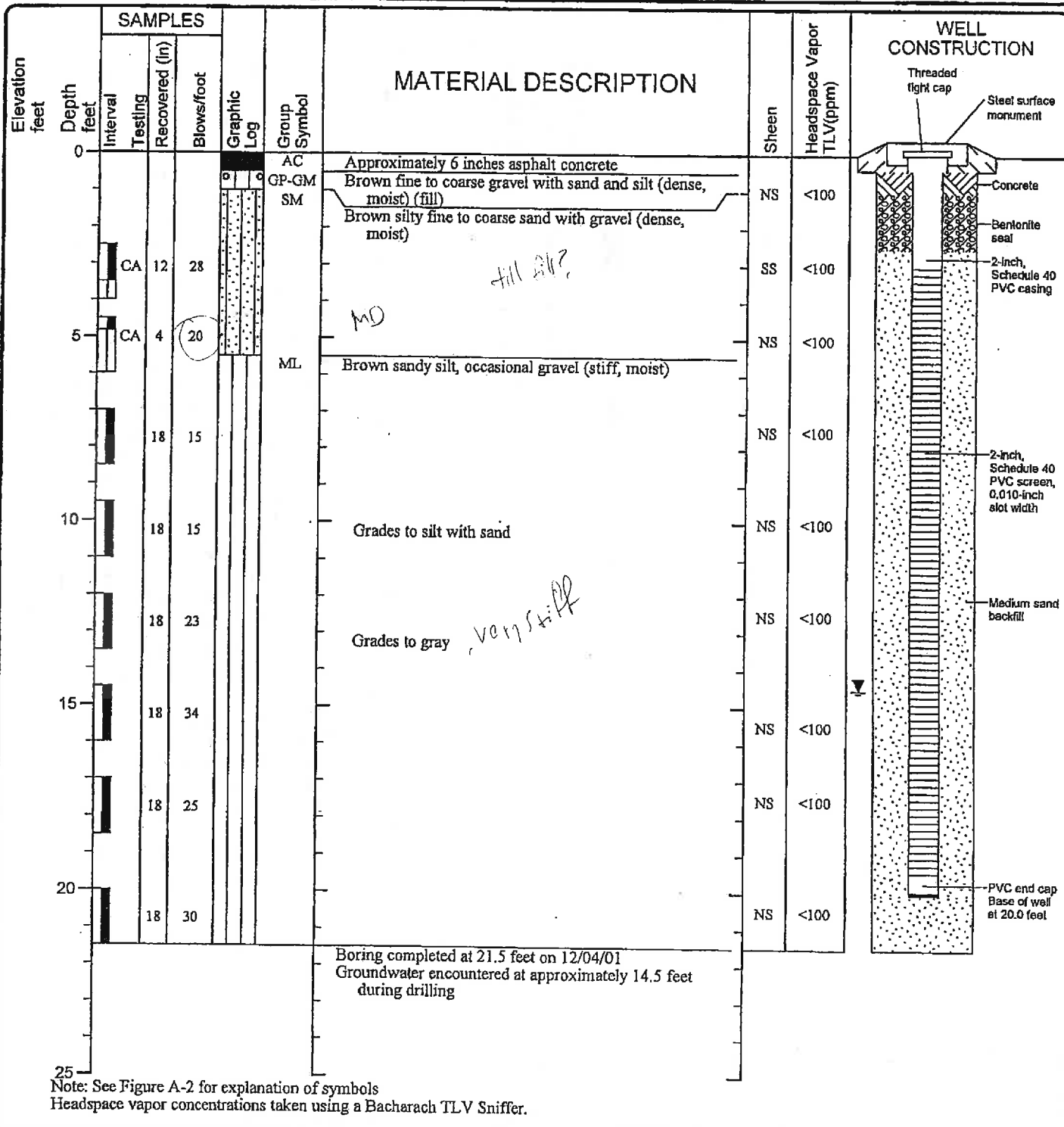
SAMPLE NUMBER	PID (ppm)	BLOWS PER 6 INCHES	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
MW9-3.5	7.8	GRAB	4/4/00					0 to 0.5 foot: SILTY GRAVEL (GM) , brown, 80 percent fine to medium angular gravel (crushed rock), 20 percent low plasticity fines, medium dense, moist. No odor.
MW9-5.5	80 422 ppb	22-36-50		5				0.5 to 1.0 foot: SANDY GRAVEL WITH SILT (GP) , olive, some yellowish mottling, 70 to 75 percent fine to medium subrounded gravel, 15 to 20 percent fine to coarse sand, 5 to 10 percent nonplastic fines, medium dense, dry to moist. No odor.
MW9-10	0.7	15-21-40	10 FP 0.5" 11/100 ATD	10				1.0 to 10.5 feet: SILTY SAND WITH GRAVEL (SM) , gray, 50 to 80 percent fine to medium and some coarse sand, 20 to 30 percent low plasticity fines, trace to 20 percent fine to medium and some coarse subrounded gravel, dense to medium dense, moist. Some fine laminations at 10 feet. Some petroleum-like odor at 5 to 7 feet. No odor at 10 feet.
MW9-15	--	25		15				10.5 to 15.5 feet: SILT (ML) , olive with some reddish staining, becoming gray to dark gray, 80 to 95 percent low plasticity to nonplastic fines, 5 to 15 percent fine sand, trace gravel, stiff to very stiff, moist to wet, becoming dry to moist at 15 feet, some fine laminations. No odor.
Total depth drilled = 15.5 feet. Total depth sampled = 15.5 feet.								
WELL COMPLETION DETAILS 0 to 4.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC blank casing. 4.7 to 14.7 feet: 2-inch diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots. 14.7 to 15.2 feet: 2-inch diameter, flush-threaded, Schedule 40 tapered PVC endcap.								
0 to 1.0 foot: concrete. 1.0 to 3.5 feet: bentonite chips hydrated with potable water. 3.5 to 15.5 feet: 10-20 Colorado silica sand.								

REMARKS

- (1) Soil samples collected using a 2-inch O.D. split spoon sampler driven using a 140-pound hammer dropped 30 inches.
 (2) PID = photoionization detector, calibrated to 100 parts per million isobutylene. (3) ATD = At Time of Drilling. (4) TOC = Top of PVC casing. (5) -- = Not measured (insufficient sample volume). (6) GRAB = Grab soil sample collected from hand auger bucket.

NOLL ENVIRONMENTAL, INC.

Date(s) Drilled	12/04/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Hollow-stem Auger	Sampling Methods	SPT
Total Boring Depth (ft)	21.5	Hammer Data	140 lbs. (lb) hammer/ 30" (in) drop	Drilling Equipment	Geoprobe® Model 5400
Well Depth (ft)	20.0	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	14.5
System/ Datum	Not Determined/Not Determined				



LOG OF MONITORING WELL MW-10



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-20
Sheet 1 of 1

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			USCS SYMBOLS		TYPICAL DESCRPTIONS	MOISTURE CONTENT
			GRAPH	LETTERS		
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.	DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH DAMP - PERCEPTIBLE MOISTURE, BUT BELOW OPTIMUM MOISTURE CONTENT FOR COMPACTION, NO FREE WATER. MOIST - PERCEPTIBLE MOISTURE, AT ABOUT OPTIMUM MOISTURE CONTENT FOR COMPACTION, NO FREE WATER. WET - VISIBLE FREE WATER IN SAMPLE, PROBABLY ABOVE OPTIMUM MOISTURE CONTENT FOR COMPACTION.
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO-FINES CONTENT.	
	MORE THAN 50% OR COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, AND GRAVEL-SAND-SILT MIXTURES.	
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, AND GRAVEL-SAND-CLAY MIXTURES.	
	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, AND GRAVELLY SANDS, WITH LITTLE OR NO FINES CONTENT.	
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.	
MORE THAN 50% OF MATERIAL IS LARGER THAN NO.200 SIEVE	MORE THAN 50% OR COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, AND SILTY SAND -SILT MIXTURES.	
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, AND SAND-CLAY MIXTURES.	
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY.	
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, AND LEAN CLAYS.	
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.	
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTY SOILS.	
				CH	INORGANIC CLAYS OF HIGH PLASTICITY.	
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY AND ORGANIC SILTS.	
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH NATURAL ORGANIC MATTER CONTENTS.	ESTIMATED SOIL PERCENTAGES TRACE - 0 TO 5 % SLIGHTLY - 5 TO 12 % NO MODIFIER - 12 TO 30 % (SILTY, SANDY) VERY - 30 TO 50 %
RELATIVE SOIL DENSITY AND CONSISTENCY						
COARSE-GRAINED SOILS						

NOTE: DUAL SYMBOLS (GP/GM) ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

FIELD MEASUREMENTS

- WATER LEVEL OBSERVED DURING DRILLING.
- STATIC WATER LEVEL MEASURED AFTER DRILLING.
- WATER SEEPAGE

LABORATORY TESTS

- M= MOISTURE CONTENT (%)
- D= DRY DENSITY (PSF)
- Tv= TORVANE
- Pp= POCKET PENETROMETER
- GS= GRAIN SIZE
- G2= % PASSING NO. 200 SIEVE
- A= ATTERBERG LIMITS

WELL CONSTRUCTION

- CONCRETE
- SOLID SCHEDULE 40 PVC WELL CASING AND BENTONITE SEAL
- SOLID SCHEDULE 40 PVC WELL CASING AND SAND FILTER PACK
- SLOTTED SCHEDULE 40 PVC WELL SCREEN AND SAND FILTER PACK
- BENTONITE

SOIL SAMPLES

- SPLIT-SPOON SAMPLE, (2-INCH O.D.), 140 LB. HAMMER (STANDARD SPT)
- SPLIT-SPOON SAMPLE, (3-INCH O.D.), 140 OR 300 LB. HAMMER (NON-STANDARD SPT)
- DIRECT-PUSH SAMPLE, USING EITHER SPLIT-SPOONS OR ACRYLIC LINERS
- GRAB SAMPLE FROM AUGER FLIGHTS OR HAND AUGER
- NO SAMPLE RECOVERY

ESTIMATED SOIL PERCENTAGES

- TRACE - 0 TO 5 %
- SLIGHTLY - 5 TO 12 %
- NO MODIFIER - 12 TO 30 %
(SILTY, SANDY)
- VERY - 30 TO 50 %

RELATIVE SOIL DENSITY AND CONSISTENCY

COARSE-GRAINED SOILS

DENSITY	SPT BLOWS PER FOOT
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	GREATER THAN 50

FINE-GRAINED SOILS


CONSISTENCY	SPT BLOWS PER FOOT
VERY SOFT	0 TO 2
SOFT	2 TO 4
MEDIUM STIFF	4 TO 8
STIFF	8 TO 15
VERY STIFF	15 TO 30
HARD	GREATER THAN 30






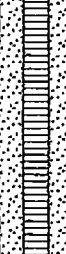








GEO SCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

FIGURE A-1

BORING LOG AND WELL SYMBOL LEGEND
FC FUELS TERMINAL PROPERTY
1702 PENNSYLVANIA AVENUE
BREMERTON, WA

 GEOSCIENCE MANAGEMENT, INC. ENVIRONMENTAL CONSULTING SERVICES 809 156TH STREET NE ARLINGTON, WA 98223	Geologist: HW Small	Date Began: 6/2/04	Boring No.: SC-MW-4A
	Driller: Cascade Drilling	Date End: 6/2/04	Casing Elevation: 94.77
	Drill Rig: Limited Access B61	Total Depth: 15.5 Feet	Depth to Water: 11 Feet

Graphic Log	Classification	Soil Description	Depth	Sampled Interval	Blow Counts	Sample Number	PID	Completion
	ML	Hard, damp, gray and oxidized brown, very fine sandy SILT.			50	S-1	3	
	SP	Very dense, moist, gray, slightly silty, fine SAND. Moderate petroleum-like odor.	5		20 50	S-2	150	
	ML	Hard, moist, brown, clayey SILT.			50	S-3	5	
	ML		10		50	S-4	20	
	SP	Very dense, wet, gray, very silty, fine sand.			50	S-5	10	
	ML	Hard, wet, brown, slightly clayey SILT.	15		50	S-6	25	

Completion Notes:

Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand.
Hydrated bentonite seal and flush-mounted surface monument.




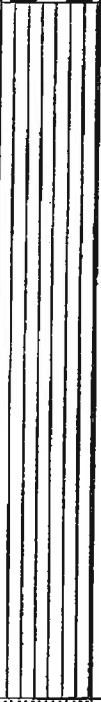

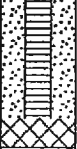
SITE:

FC Fuels Terminal Investigation
1702 Pennsylvania Avenue
Bremerton, WA

Project No.: 3057.02

Page:

1

 GEO SCIENCE MANAGEMENT, INC. ENVIRONMENTAL CONSULTING SERVICES 809 156TH STREET NE ARLINGTON, WA 98223		Geologist: HW Small	Date Began: 6/2/04	Boring No.: SC-MW-11				
		Driller: Cascade Drilling	Date End: 6/2/04	Casing Elevation: 93.60				
		Drill Rig: Limited Access B61	Total Depth: 15.5 Feet	Depth to Water: 10 Feet				
Graphic Log	Classification	Soil Description	Depth	Sampled Interval	Blow Counts	Sample Number	PID	Completion
	GP	Gravel Fill						
	ML	Hard, damp to moist, gray and oxidized brown, slightly fine sandy, clayey SILT. <i>Qph?</i>						
					15 25 30	S-1	<1	
			5		15 21 30	S-2	<1	
					50	S-3	<1	
			10		28 50	S-4	<1	
					50	S-5	<1	
	SP	Very dense, wet, gray, very silty, fine SAND.	15		50	S-6	<1	
Completion Notes: Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand. Hydrated bentonite seal and flush-mounted surface monument.			SITE: FC Fuels Terminal Investigation 1702 Pennsylvania Avenue Bremerton, WA					
			Project No.: 3057.02		Page: 1			



GEOSCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

Geologist: HW Small

Date Began: 6/2/04

Boring No.: **SC-MW-12**

Driller: Cascade Drilling

Date End: 6/2/04

Casing Elevation: 95.83

Drill Rig: Limited Access B61

Total Depth: 15.5 Feet

Depth to Water: 7 Feet

Graphic Log	Classification	Soil Description	Depth	Sampled Interval	Blow Counts	Sample Number	PID	Completion
	GP	Gravel Fill.						
	ML	Hard, damp, gray and oxidized brown, very fine sandy SILT.			50	S-1	<1	
	SP	Very dense, moist, gray, slightly silty, fine SAND. Moderate petroleum-like odor.	5		50	S-2	<1	
	ML	Hard, moist, brown, clayey SILT.			50	S-3	10	
	SP	Very dense, wet, gray, very silty, fine sand.	10		50	S-4	4	
	SP				50	S-5	<1	
	ML	Hard, wet, brown, slightly clayey SILT.	15		50	S-6	<1	

Completion Notes:

Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand.
Hydrated bentonite seal and flush-mounted surface monument.

SITE:

FC Fuels Terminal Investigation
1702 Pennsylvania Avenue
Bremerton, WA

Project No.:

3057.02

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GEO SCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

Geologist: HW Small

Date Began: 6/10/04

Boring No.: **SG-MW-13**

Driller: Cascade Drilling

Date End: 6/10/04

Casing Elevation: 90.80

Drill Rig: Limited Access B61

Total Depth: 15.5 Feet

Depth to Water: 9 Feet

Graphic Log	Classification	Soil Description	Depth	Sample Interval	Blow Counts	Sample Number	PID	Completion
	GP	Gravel Fill Stiff, damp to moist, tan and oxidized brown, slightly fine sandy, clayey SILT.						
	ML		5		3 4 5	S-1	<1	
	SP sm	Dense, wet, gray-brown, silty, fine SAND, with fine scattered gravels. <i>glacial?</i>	10		11 20 21	S-2	<1	
	ML	Hard, moist to wet, tan and oxidized brown, finely laminated, trace to slightly fine sandy, clayey SILT. <i>QpLn?</i>	15		50/4	S-3	<1	

Completion Notes:

Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand.
Hydrated bentonite seal and flush-mounted surface monument.

SITE:

FC Fuels Terminal Investigation
1702 Pennsylvania Avenue
Bremerton, WA

Project No.: 3057.02

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GEO SCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

Geologist: HW Small

Date Began: 6/10/04

Boring No.: **SG-MW-14**

Driller: Cascade Drilling

Date End: 6/10/04

Casing Elevation: 89.12

Drill Rig: Limited Access B61

Total Depth: 15.5 Feet

Depth to Water: 13 Feet

Graphic Log	Classification	Soil Description	Depth	Sampled Interval	Blow Counts	Sample Number	PID	Completion
	GP	Gravel Fill Very dense, damp, light brown, fine SAND.						
	SM		5		50	S-1	<1	
	ML	Hard, damp to moist, tan and oxidized brown, clayey SILT, with occasional sand interbeds up to 1-inch thick.	10		50	S-2	<1	
			15		50	S-3	<1	

Completion Notes:

Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand.
Hydrated bentonite seal and flush-mounted surface monument.

SITE:

*FC Fuels Terminal Investigation
1702 Pennsylvania Avenue
Bremerton, WA*

Project No.: 3057.02

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GEOSCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

Geologist: HW Small

Date Began: 6/10/04

Boring No.: **SC-MW-15**

Driller: Cascade Drilling

Date End: 6/10/04

Casing Elevation: 88.89

Drill Rig: Limited Access B61

Total Depth: 15.5 Feet

Depth to Water: 10 Feet

Graphic Log	Classification	Soil Description	Depth	Sampled Interval	Blow Counts	Sample Number	PID	Completion
	SM	Very dense, damp, light brown, fine SAND.	5		40 50	S-1	<1	
	SP	Very dense, wet, gray, silty fine SAND, trace fine gravels.	10		50/4	S-2	<1	
	ML	Hard, damp to moist, tan and oxidized brown, finely laminated (1/16-inch thick) clayey SILT.	15		50	S-3	<1	

Completion Notes:

Installed 10 feet of 2-inch, 10-slot PVC well screen surrounded by 2-12 silica sand.
Hydrated bentonite seal and flush-mounted surface monument.

SITE:

FC Fuels Terminal Investigation
1702 Pennsylvania Avenue
Bremerton, WA

Project No.: 3057.02

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KEY TO ABBREVIATIONS

Drilling Method

HSA - Hollow stem auger
CFA - Continuous flight auger
Air - Reverse air circulation

Gravel Pack

CA - Coarse aquarium sand

Sampling Method

SS - Split-spoon sampler (1.5" inner diameter) driven 18" by a 140-pound hammer having a 30" drop. Where penetration resistance is designated "P", sampler was instead pushed by drill rig.
Disturbed - Sample taken from drill-return materials as they surfaced.
Shelby - Shelby Tube thin-walled sampler (3" diameter), where sampler is pushed by drill-rig.

Moisture Content

Dry - Dry
Dp - Damp
Mst - Moist
Wt - Wet

Sorting

PS - Poorly sorted
MS - Moderately sorted
WS - Well sorted

Plasticity

L - Low
M - Moderate
H - High

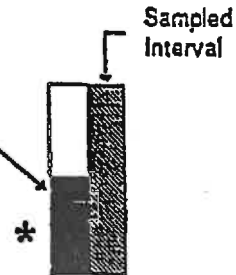
PID (ppm)

ND - No detection

Symbols

▽ - First encountered ground water
▼ - Static ground water level

Sample Recovery
* Sample submitted for laboratory analysis



Density (Blows/Foot - Split Spoon Sampler)

Sands and gravels

0 - 4 - Very Loose
4 - 10 - Loose
10 - 30 - Medium dense
30 - 50 - Dense
over 50 - Very dense

Silts and Clays

0 - 2 - Very Soft
2 - 4 - Soft
4 - 8 - Firm
8 - 16 - Stiff
16 - 32 - Very Stiff
32 - 50 - Hard
over 50 - Very Hard

GRAIN - SIZE SCALE

GRADE LIMITS

U.S. Standard

GRADE NAME

inch	sieve size	
12.0		Boulders
3.0	3.0 in.	Cobbles
0.19	No. 4	Gravels
0.08	No. 10	coarse
	No. 40	medium
	No. 200	fine
		Silt
		Clay Size

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			USCS SYMBOLS		TYPICAL DESCRIPTIONS	MOISTURE CONTENT	
			GRAPH	LETTERS			
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.	DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH DAMP - PERCEPTIBLE MOISTURE, BUT BELOW OPTIMUM MOISTURE CONTENT FOR COMPACTION. NO FREE WATER. MOIST - PERCEPTIBLE MOISTURE, AT ABOUT OPTIMUM MOISTURE CONTENT FOR COMPACTION. NO FREE WATER. WET - VISIBLE FREE WATER IN SAMPLE. PROBABLY ABOVE OPTIMUM MOISTURE CONTENT FOR COMPACTION.	
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.		
	MORE THAN 50% OF MATERIAL IS LARGER THAN NO.200 SIEVE	MORE THAN 50% OR COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM		SILTY GRAVELS, AND GRAVEL-SAND-SILT MIXTURES.
			CLEAN GRAVELS (LITTLE OR NO FINES)		GC		CLAYEY GRAVELS, AND GRAVEL-SAND-CLAY MIXTURES.
		SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW		WELL-GRADED SANDS, AND GRAVELLY SANDS, WITH LITTLE OR NO FINES CONTENT.
			POORLY-GRADED SANDS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.		SP		POORLY-GRADED SANDS, AND GRAVEL-SAND MIXTURES, WITH LITTLE OR NO FINES CONTENT.
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY.	ESTIMATED SOIL PERCENTAGES TRACE - 0 TO 5 % SLIGHTLY - 5 TO 12 % NO MODIFIER - 12 TO 30 % (SILTY, SANDY) VERY - 30 TO 50 %	
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, AND LEAN CLAYS.		
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.		
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTY SOILS.		
				CH	INORGANIC CLAYS OF HIGH PLASTICITY.		
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY AND ORGANIC SILTS.		
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH NATURAL ORGANIC MATTER CONTENTS.			

NOTE: DUAL SYMBOLS (GP/GM) ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

FIELD MEASUREMENTS

WATER LEVEL OBSERVED DURING DRILLING.

STATIC WATER LEVEL MEASURED AFTER DRILLING.

WATER SEEPAGE

LABORATORY TESTS

M= MOISURE CONTENT (%)
D= DRY DENSITY (PSF)
Tv= TORVANE
Pp= POCKET PENETROMETER
GS= GRAIN SIZE
G2= % PASSING NO. 200 SIEVE
A= ATTERBERG LIMITS

WELL CONSTRUCTION

CONCRETE

SOLID SCHEDULE 40 PVC WELL CASING AND BENTONITE SEAL

SOLID SCHEDULE 40 PVC WELL CASING AND SAND FILTER PACK

SLOTTED SCHEDULE 40 PVC WELL SCREEN AND SAND FILTER PACK

BENTONITE

SOIL SAMPLES

SPLIT-SPOON SAMPLE, (2-INCH O.D.) 140 LB. HAMMER (STANDARD SPT)

SPLIT-SPOON SAMPLE, (3-INCH O.D.) 140 OR 300 LB. HAMMER (NON-STANDARD SPT)

DIRECT-PUSH SAMPLE, USING EITHER SPLIT-SPOONS OR ACRYLIC LINERS

GRAB SAMPLE FROM AUGER FLIGHTS OR HAND AUGER

NO SAMPLE RECOVERY

RELATIVE SOIL DENSITY AND CONSISTENCY

COARSE-GRAINED SOILS

DENSITY	SPT BLOWS PER FOOT
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	GREATER THAN 50

FINE-GRAINED SOILS

CONSISTENCY	SPT BLOWS PER FOOT
VERY SOFT	0 TO 2
SOFT	2 TO 4
MEDIUM STIFF	4 TO 8
STIFF	8 TO 15
VERY STIFF	15 TO 30
HARD	GREATER THAN 30

NOTE: DUAL SYMBOLS (GP/GM) ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

FIELD MEASUREMENTS



WATER LEVEL OBSERVED DURING DRILLING.



STATIC WATER LEVEL MEASURED AFTER DRILLING.



WATER SEEPAGE

LABORATORY TESTS

M= MOISTURE CONTENT (%)
D= DRY DENSITY (PSF)
Tv= TORVANE
Pp= POCKET PENETROMETER
GS= GRAIN SIZE
G2= % PASSING NO. 200 SIEVE
A= ATTERBERG LIMITS

WELL CONSTRUCTION



CONCRETE



SOLID SCHEDULE 40 PVC WELL CASING AND BENTONITE SEAL



SOLID SCHEDULE 40 PVC WELL CASING AND SAND FILTER PACK



SLOTTED SCHEDULE 40 PVC WELL SCREEN AND SAND FILTER PACK



BENTONITE

SOIL SAMPLES



SPLIT-SPOON SAMPLE, (2-INCH O.D.) 140 LB. HAMMER (STANDARD SPT)



SPLIT-SPOON SAMPLE, (3-INCH O.D.) 140 OR 300 LB. HAMMER (NON-STANDARD SPT)



DIRECT-PUSH SAMPLE, USING EITHER SPLIT-SPOONS OR ACRYLIC LINERS



GRAB SAMPLE FROM AUGER FLIGHTS OR HAND AUGER



NO SAMPLE RECOVERY



GEO SCIENCE MANAGEMENT, INC.
 ENVIRONMENTAL CONSULTING SERVICES
 809 156TH STREET NE
 ARLINGTON, WA 98223

FIGURE A-1

BORING LOG AND WELL SYMBOL LEGEND
 FC FUELS TERMINAL PROPERTY
 1702 PENNSYLVANIA AVENUE
 BREMERTON, WA

Primary Divisions		Group Symbol/Graphic		Typical Names
COARSE GRAINED SOILS more than half is larger than #200 sieve	GRAVELS half of coarse fraction larger than #4 sieve	CLEAN GRAVELS (less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures; little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures; little or no fines
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS half of coarse fraction smaller than #4 sieve	CLEAN SANDS (less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands; little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS more than half is smaller than #200 sieve	SILTS AND CLAYS liquid limit less than 50%		ML	Inorganic silts and very fine sand, rock flour, silty or clayey fine sands or clayey silts, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS liquid limit more than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PI	Peat and other highly organic soils	



PACIFIC
ENVIRONMENTAL
GROUP, INC.

Unified Soil Classification System

Pennsylvania, Street



1
N
1

BORING NO. HA-1
PAGE 1 OF 1

PROJECT NO. 512-001.1A
LOGGED BY: B.A.
DRILLER: B.A.
DRILLING METHOD: HAND AUGER
SAMPLING METHOD: HAND AUGER
CASING TYPE: NA
SLOT SIZE: NA
WELL PACK: NA

CLIENT: TOSCO
DATE DRILLED: 8-21-97
LOCATION: BREMERTON, WA
HOLE DIAMETER: 3.5"
HOLE DEPTH: 6'
WELL DIAMETER: NA
WELL DEPTH: NA
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled with Cuttings	Dry	240		* 1			CL	CONCRETE 1" GRAVEL FILL 6"
	Dp	30		2				CLAY: olive gray; low plasticity; 20% fine sand; brown mottling.
	Dp	20		3				CLAYEY SAND
				4				
				5				
				* 6			SM	SILTY SAND: olive gray; 40% fines; very fine to fine sand.
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

LOCATION MAP

Pennsylvania Street

HA-3

N

PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. HA-3

PAGE 1 OF 1

PROJECT NO. 512-001.1A

CLIENT: TOSCO

LOGGED BY: B.A.

DATE DRILLED: 8-21-97

DRILLER: B.A.

LOCATION: BREMERTON, WA

DRILLING METHOD: HAND AUGER

HOLE DIAMETER: 3.5"

SAMPLING METHOD: HAND AUGER

HOLE DEPTH: 3.2'

CASING TYPE: NA

WELL DIAMETER: NA

SLOT SIZE: NA

WELL DEPTH: NA

WELL PACK: NA

CASING STICKUP: NA

WELL
COMPLETIONMOISTURE
CONTENT

PID

PENETRATION
(BLOWS/FT)DEPTH
(FEET)RECOVERY
SAMPLE INTERVAL

GRAPHIC

SOIL TYPE

LITHOLOGY / REMARKS

Backfilled
with
Cuttings

Dp

40

5

*

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

ML

CONCRETE 1" SANDY GRAVEL 5"

SILT: brown with gray mottling.

@ 1': as above; gray.

SM

SILTY SAND: 50% fines; very fine to fine sand.

' BOTTOM OF BORING 3.2'

LOCATION MAP

Pennsylvania Street

HA-5

N

PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. HA-5

PAGE 1 OF 1

PROJECT NO. 512-001.1A

LOGGED BY: B.A.

DRILLER: B.A.

DRILLING METHOD: HAND AUGER

SAMPLING METHOD: HAND AUGER

CASING TYPE: NA

SLOT SIZE: NA

WELL PACK: NA

CLIENT: TOSCO

DATE DRILLED: 8-21-97

LOCATION: BREMERTON, WA

HOLE DIAMETER: 3.5"

HOLE DEPTH: 6'

WELL DIAMETER: NA

WELL DEPTH: NA

CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Backfilled with Cuttings	Dry	0		1			SM	SILTY SAND: brown; 20% fines.
				2				
				3			SC	CLAYEY SAND: gray; 70% fines; 30% fine sand; roots; trace wood material; shēen.
		112		4				
				5				
	Mst	219		6				BOTTOM OF BORING 6'
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More Than 50% Retained on No. 200 Sieve	GRAVEL More Than 50% of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More Than 50% of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More Than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less Than 50	INORGANIC	ML	SILT
			CL	CLAY
	SILT AND CLAY Liquid Limit 50 or More	ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
		INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
			HIGHLY ORGANIC SOILS	

NOTES:

- Field classification is based on visual examination of soil in general accordance with ASTM D2488-93.
- Soil classification using laboratory tests is in general accordance with ASTM D2487-98.
- Descriptions of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp, but no visible water
- Wet - Visible free water or saturated, usually soil is obtained from below water table

Date(s) Drilled	12/06/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	N/A	Drilling Method	N/A	Sampling Methods	Disturbed
Auger Data	N/A	Hammer Data	N/A	Drilling Equipment	Hand Tools
Total Depth (ft)	3.5	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	
Datum/System	Not Determined/Not Determined				

Elevation feet	Depth feet	SAMPLES					MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
		Interval	Testing	Recovered (in)	Blows/foot	Water Level				
0							CC GP-GM			Approximately 1.5 inches concrete Brown fine to coarse gravel with sand and silt (dense, moist) (fill)
				24			SM			Brown silty fine to medium sand with gravel
		CA						HS	24.2	HA-6-I-3
				6				NS	1.2	
5										
10										
							Boring completed at 3.5 feet because of refusal on 12/06/01 No groundwater encountered			

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an organic vapor analyzer.

LOG OF HAND AUGER BORING HA-6



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-3
Sheet 1 of 1

Date(s) Drilled	12/06/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	N/A	Drilling Method	N/A	Sampling Methods	Disturbed
Auger Data	N/A	Hammer Data	N/A	Drilling Equipment	Hand Tools
Total Depth (ft)	3	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	
Datum/ System	Not Determined/Not Determined				

Elevation feet	Depth feet	SAMPLES					MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
		Interval	Testing	Recovered (in)	Blows/foot	Water Level	Graphic Log	Group Symbol		
0								CC		
								GP		Approximately 2 inches concrete Brown fine to coarse gravel with sand and silt (dense, moist) (fill)
				24				SM		Gray silty fine to medium sand with gravel and root debris (fill)
		CA							HS	Becomes black, apparent staining (heavy petroleum odor)
										Boring completed at 3.0 feet because of refusal on 12/06/01 No groundwater encountered
5										
10										

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an organic vapor analyzer.

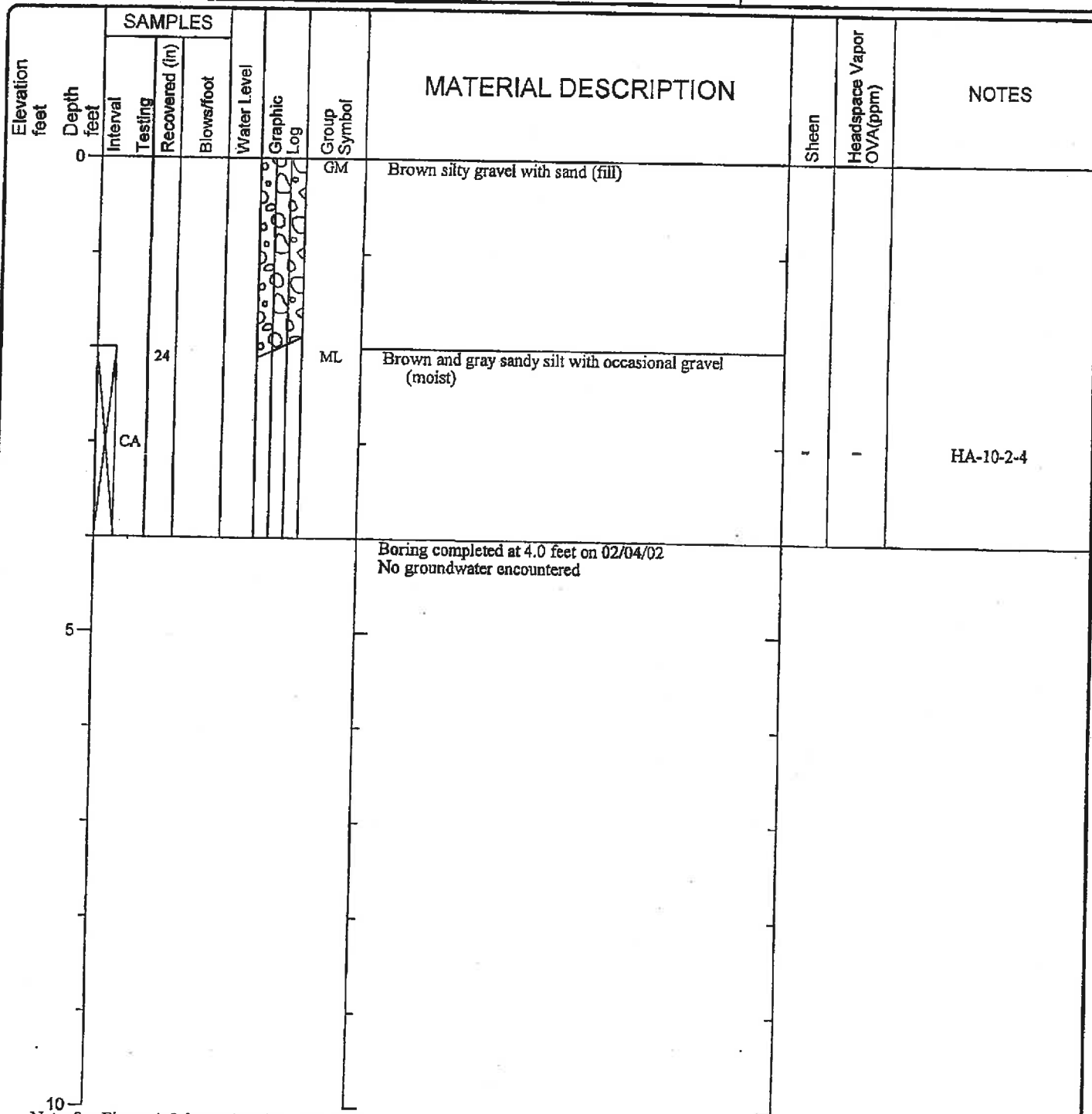
LOG OF HAND AUGER BORING HA-7



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-4
Sheet 1 of 1

Date(s) Drilled	02/04/02	Logged By	Erik A. Hedberg	Checked By	Marsi M. Beeson
Drilling Contractor	N/A	Drilling Method	Hand Auger	Sampling Methods	Disturbed
Auger Data	N/A	Hammer Data	N/A	Drilling Equipment	Hand Tools
Total Depth (ft)	4	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	
Datum/ System	Not Determined/Not Determined				



Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an organic vapor analyzer.

LOG OF HAND AUGER BORING HA-10



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01.

Figure: A-7
Sheet 1 of 4

Date(s) Drilled	02/04/02	Logged By	Erik A. Hedberg	Checked By	Marsi M. Beeson
Drilling Contractor	N/A	Drilling Method	Hand Auger	Sampling Methods	Disturbed
Auger Data	N/A	Hammer Data	N/A	Drilling Equipment	Hand Tools
Total Depth (ft)	4	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	
Datum/System	Not Determined/Not Determined				

Elevation feet	Depth feet	SAMPLES					MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
		Interval	Testing	Recovered (in)	Blows/foot	Water Level				
0							GP			Gravel with sand and brown silt (fill)
							SP-SM			Brown fine to coarse gravelly sand with silt
							SM			Grayish brown silty sand with occasional gravel (moist)
		CA		24				-	-	HA-11-2-4
10										Boring completed at 4.0 feet on 02/04/02 No groundwater encountered

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an organic vapor analyzer.

LOG OF HAND AUGER BORING HA-11



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-8
Sheet 1 of 1

Date(s) Drilled	02/05/02	Logged By	Erik A. Hedberg	Checked By	Marsi M. Beeson
Drilling Contractor	N/A	Drilling Method	Hand Auger	Sampling Methods	Disturbed
Auger Data	N/A	Hammer Data	N/A	Drilling Equipment	Hand Tools
Total Depth (ft)	2.5	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	
Datum/System	Not Determined/Not Determined				

Elevation feet	Depth feet	SAMPLES					MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
		Interval	Testing	Recovered (in)	Blows/foot	Water Level				
0							2 inches concrete (deteriorated) Brown silty fine to coarse gravel (dense, moist) (fill)			
		CA	18				Brown silty fine to medium sand with gravel			HA-13-1-2.5
							Boring completed at 2.5 feet because of refusal on large rocks on 02/05/02 No groundwater encountered			

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an organic vapor analyzer.

LOG OF HAND AUGER BORING HA-13



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-10
Sheet 1 of 1

Date(s) Drilled	12/04/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	11.0
Datum/System	Not Determined/Not Determined				

Elevation feet	SAMPLES				Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)	NOTES
	Depth feet	Interval	Testing Recovered (in)	Blows/foot					
0			46		GM	Brown silty gravel with sand (fill)	SS	<100	
		CA	46		ML	Brownish gray sandy silt, occasional gravel (medium dense) (moderate petroleum odor)	HS	150	SP-11-2-4
5			46			(slight petroleum odor)	MS	<100	
		CA	46			(slight petroleum odor)	MS	<100	SP-11-8-10
10			48		SM	Brown silty sand, pea gravel (wet)	MS	<100	
							SS	<100	
15							SS	<100	
20						Boring completed at 16.0 feet on 12/04/01 Groundwater encountered at approximately 11.0 feet during drilling			
25									

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using a Bacharach TLV Sniffer.

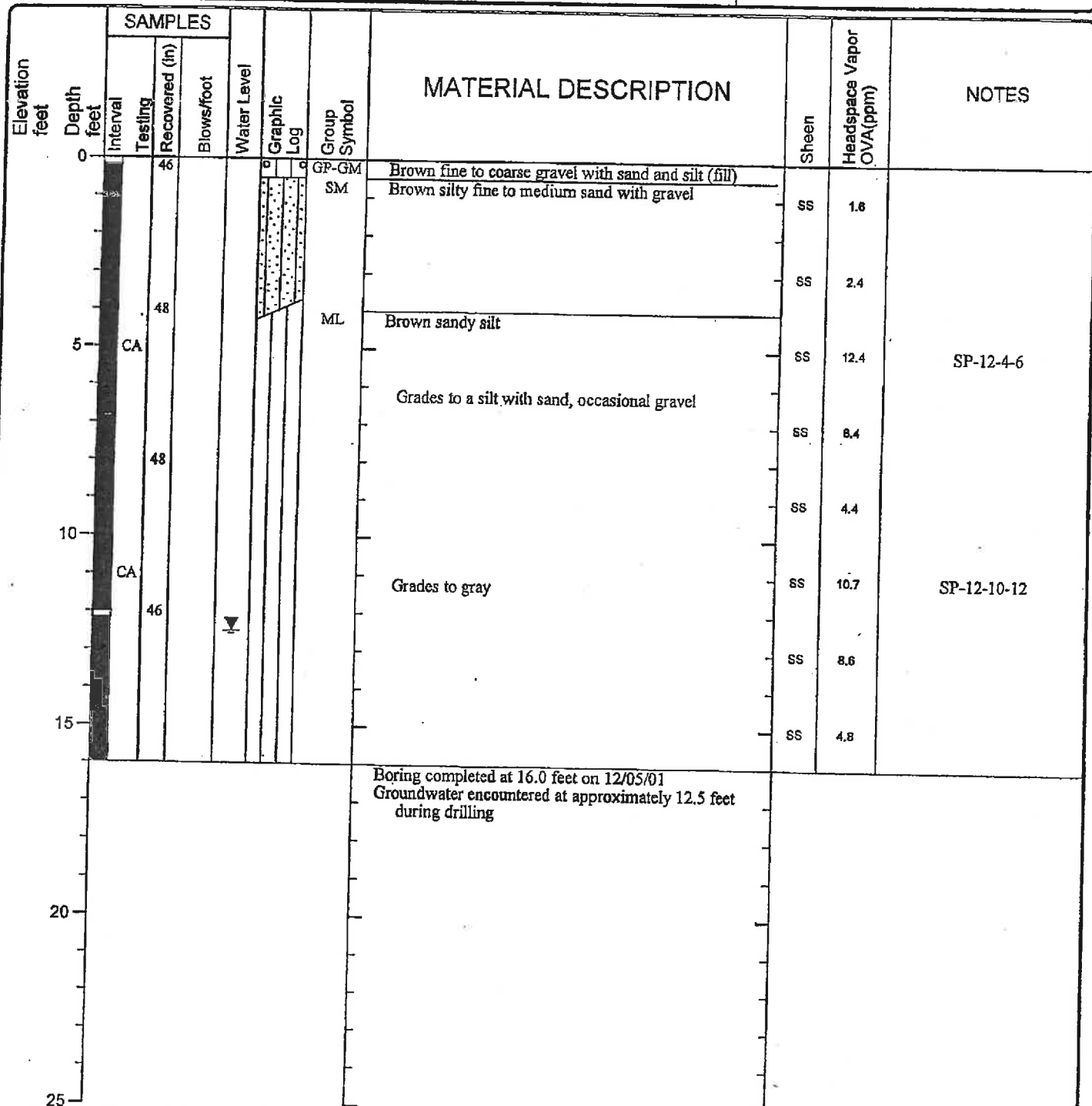
LOG OF DIRECT-PUSH BORING SP-11



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-12
Sheet 1 of 1

Date(s) Drilled	12/05/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	12.5
Datum/System	Not Determined/Not Determined				



LOG OF DIRECT-PUSH BORING SP-12



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-13
Sheet 4 of 4

Date(s) Drilled	12/04/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	6.5
Datum/ System	Not Determined/Not Determined				

Elevation feet	SAMPLES				Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)	NOTES
	Interval	Testing	Recovered (in)	Blows/foot						
0			48			GM	Brown silty fine to coarse gravel with sand (fill)			
						SP-SM	Brown fine to coarse sand with gravel and silt (fill)	NS	<100	
	CA					SM	Brown silty fine to medium sand with gravel	SS	<100	SP-13-2-4
5	CA		46					SS	<100	SP-13-4-6
						SP-SM	Brown fine to coarse sand with silt, occasional gravel	SS	<100	
			46			SM	Brown silty fine to medium sand, occasional gravel	NS	<100	
10								NS	<100	
			48					NS	<100	
15						ML	Gray silt with sand (very dense, moist)	NS	<100	
							Boring completed at 16.0 feet on 12/04/01 Groundwater encountered at approximately 6.5 feet during drilling			
20										
25										

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using a Bacharach TLV Sniffer.

LOG OF DIRECT-PUSH BORING SP-13



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-14
Sheet 1 of 1

Date(s) Drilled	12/04/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	10.0
Datum/ System	Not Determined/Not Determined				

Elevation feet	SAMPLES				Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
	Interval	Testing Recovered (in)	Blows/foot	Water Level						
0		46				GP-GM	Brown fine to coarse gravel with sand and silt (moist) (fill)	NS	0.0	SP-15-4-6
						SP-SM	Brown fine to medium sand with gravel and silt (moist) (fill)			
						SM	Brown silty fine to medium sand with gravel (moist)	SS	12.4	
5	CA	42						MS	22.6	
						ML	Brown silty fine to medium sand (moist)	SS	16.8	SP-15-10-12
		48						SS	24.8	
10	CA						Grades to wet	SS-MS	70.3	
		48						SS	123	
15							(moderate petroleum odor)	SS	56.4	
20										
25										

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using a Bacharach TLV Sniffer and OVA.

LOG OF DIRECT-PUSH BORING SP-15



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-16
Sheet 1 of 1

Date(s) Drilled	12/05/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	7.5 and 13.0
Datum/System	Not Determined/Not Determined				

Elevation feet	SAMPLES				Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
	Depth feet	Interval Testing	Recovered (in)	Blows/foot					
0					GW	Brown fine to coarse gravel with sand, trace silt (moist) (fill)			SP-16-2-4
					SM	Brown silty fine to medium sand with gravel (moist)	SS	0.4	
		CA					SS	0.0	
		48					SS	0.0	
5					SP-SM	Brown fine to medium sand, occasional gravel (moist)	SS	0.2	SP-16-10-12
						Encountered silt bed (wet)	SS	0.0	
		40			SM	Brown silty fine to medium sand with gravel (moist)	SS	0.0	
					SP-SM	Brown fine to coarse sand with silt, occasional gravel (moist)	SS	1.2	
		CA					SS	1.2	
		48			SM	Brown silty fine to medium sand, occasional gravel (wet)	NS	0.0	
15							NS	0.0	
25						Boring completed at 16.0 feet on 12/05/01 Groundwater encountered at approximately 7.5 and 13.0 feet during drilling			

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an OVA.

LOG OF DIRECT-PUSH BORING SP-16



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-17

Date(s) Drilled	12/05/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	12.0
Datum/ System	Not Determined/Not Determined				

Elevation feet	SAMPLES					MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
	Interval	Testing Recovered (in)	Blows/foot	Water Level	Graphic Log				
0		46				GP-GM SM Brown fine to coarse gravel with sand and silt (moist) (fill) Brown silty fine to medium sand, occasional gravel (dense, moist)	SS	0.0	SP-17-4-6
						Gray staining	SS	0.2	
5	CA	48				ML Brownish gray silt with sand (soft, moist)	SS	1.2	
						Intermittent brown layers to approximately 7.0 feet Grades to brown	SS	0.8	SP-17-8-10
	CA	42					SS	0.9	
10							NS	0.0	
		48				Grades to wet	NS	0.0	
15							NS	0.0	
25						Boring completed at 16.0 feet on 12/05/01 Groundwater encountered at approximately 12.0 feet during drilling			

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an OVA.

LOG OF DIRECT-PUSH BORING SP-17



Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-18
Sheet 1 of 1

Date(s) Drilled	12/05/01	Logged By	Scott L. McDonald	Checked By	Marsi M. Beeson
Drilling Contractor	Geo-Tech Explorations, Inc.	Drilling Method	Geoprobe® Direct Push	Sampling Methods	Discrete Piston Sampler
Auger Data	Not Applicable	Hammer Data	Hydraulic Percussion	Drilling Equipment	Geoprobe® Model 5400
Total Depth (ft)	16	Surface Elevation (ft)	Not Measured	Groundwater Level (ft. bgs)	10.5
Datum/System	Not Determined/Not Determined				

Elevation feet	SAMPLES				Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor OVA(ppm)	NOTES
	Interval Depth feet	Testing Recovered (in)	Blows/foot	Water Level					
0		40			GP-GM	Brown fine to coarse gravel with silt and sand (dense, moist) (fill)			
					SP-SM	Brown fine to medium sand with gravel and silt (dense, moist) (fill)	NS	0.0	
	CA	48			SM	Brown silty fine to medium sand, occasional gravel (dense, moist)	NS	0.0	SP-18-2-4
5							NS	0.0	
		48			ML	Brown sandy silt, occasional gravel (stiff, moist)	NS	0.0	
	CA	48			SP-SM	Brown fine to coarse sand with silt and gravel (dense, moist)	SS	0.0	SP-18-8-10
10							SS	0.0	
		48			ML	Grades to wet Gray silt with sand, occasional gravel (very stiff, moist)	SS	0.9	
							SS	1.2	
15							SS	0.0	
20									
25									

Note: See Figure A-2 for explanation of symbols
Headspace vapor concentrations taken using an OVA.

LOG OF DIRECT-PUSH BORING SP-18

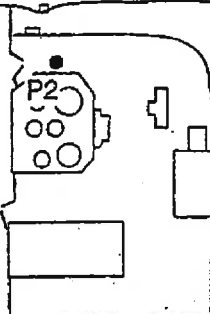


Project: Tosco Corporation
Project Location: Bremerton, Washington
Project Number: 4823-501-01

Figure: A-19
Sheet 1 of 1

LOCATION MAP

Pennsylvania Street



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. P2

PAGE 1 OF 1

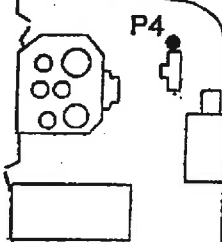
PROJECT NO. 512-001.1A
 LOGGED BY: M.M.
 DRILLER: VIRONEX
 DRILLING METHOD: GEOPROBE
 SAMPLING METHOD: CONT. CORE
 CASING TYPE: NA
 SLOT SIZE: NA
 WELL PACK: NA

CLIENT: TOSCO
 DATE DRILLED: 8-21-97
 LOCATION: BREMERTON, WA
 HOLE DIAMETER: 2"
 HOLE DEPTH: 12'
 WELL DIAMETER: NA
 WELL DEPTH: NA
 CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Concrete Backfilled with Bentonite	Dry			1		GP	GP	GRAVEL SURFACE SANDY GRAVEL FILL
				2		SC	SC	CLAYEY SAND: olive gray to dark brown; 30 to 40% fines; trace gravel; trace roots; slight hydrocarbon odor.
	Dp	136		3		CL	CL	CLAY: brown to dark gray.
	Wt			4	*	SC	SC	CLAYEY SAND: dark gray to olive gray; 30% fines; fine sand; trace iron oxide staining; trace gravel; hydrocarbon odor.
	Mst	92		5				
				6				
	Mst			7				
				8				
	Mst			9		CL	CL	CLAY: olive gray; moderate plasticity; 5 to 10% very fine sand; trace gravel; abundant iron oxide staining; no hydrocarbon odor.
	Dp	12		10				
				11				
				12	*			BOTTOM OF BORING 12'
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

LOCATION MAP

Pennsylvania Street



N

PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. P4

PAGE 1 OF 1

PROJECT NO. 512-001.1A

LOGGED BY: M.M.

DRILLER: VIRONEX

DRILLING METHOD: GEOPROBE

SAMPLING METHOD: CONT. CORE

CASING TYPE: NA

SLOT SIZE: NA

WELL PACK: NA

CLIENT: TOSCO

DATE DRILLED: 8-21-97

LOCATION: BREMERTON, WA

HOLE DIAMETER: 2"

HOLE DEPTH: 14'

WELL DIAMETER: NA

WELL DEPTH: NA

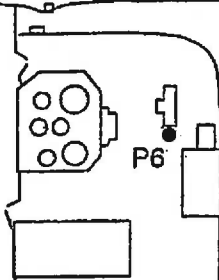
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Concrete								
Backfilled with Bentonite	Dry	2		1			SC	GRAVEL SURFACE
				2				CLAYEY SAND: fill; brown to olive to dark gray; 20% fines; very fine to fine sand; trace medium to coarse sand; trace gravel; iron oxide staining; no hydrocarbon odor above 3'; slight hydrocarbon odor.
		3		3				
				4				@5': as above; dark gray.
	Dp			5				
				6				
		470		* 7				
	Dp	60		* 8			SC	SANDY CLAY: dark gray; low plasticity; 40% very fine to fine sand; iron oxide staining; hydrocarbon odor.
				9				
				10				
		402		11				@11': clay; olive; to dark gray; silty; interbedded sand lenses; iron oxide staining; hydrocarbon odor.
	Dp			12			ML	SILT: olive gray; clayey; low plasticity; trace very fine sand; iron oxide staining; no hydrocarbon odor.
				13				
	Wt	3		* 14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

BOTTOM OF BORING 14'

LOCATION MAP

Pennsylvania Street



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. P6

PAGE 1 OF 1

PROJECT NO. 512-001.1A

LOGGED BY: M.M.

DRILLER: VIRONEX

DRILLING METHOD: GEOPROBE

SAMPLING METHOD: CONT. CORE

CASING TYPE: NA

SLOT SIZE: NA

WELL PACK: NA

CLIENT: TOSCO

DATE DRILLED: 8-21-97

LOCATION: BREMERTON, WA

HOLE DIAMETER: 2"

HOLE DEPTH: 10'

WELL DIAMETER: NA

WELL DEPTH: NA

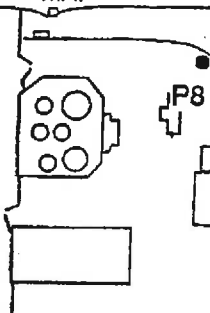
CASING STICKUP: NA

WELL COMPLETION	MOISTURE CONTENT	PID	PENETRATION (BLOWS/FT)	DEPTH (FEET)	RECOVERY SAMPLE INTERVAL	GRAPHIC	SOIL TYPE	LITHOLOGY / REMARKS
Concrete Backfilled with Bentonite				1			SC	GRAVEL
				2				CLAYEY SAND: fill; olive gray; 20 to 30% fines; very fine sand; 5% fine to coarse sand; trace gravel; trace iron oxide staining; no hydrocarbon odor.
				3				
	Dp	283		* 4				
				5				
				6				
	Dp	55		7			CL	CLAY: olive gray; low plasticity; 10% very fine sand; trace fine to coarse sand; trace gravel; iron oxide staining; no hydrocarbon odor.
				8				
				9				
	Dp	9		* 10				@10': interbedded clayey sand lenses; slight hydrocarbon odor.
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

BOTTOM OF BORING 10'

LOCATION MAP

Pennsylvania Street



PACIFIC ENVIRONMENTAL GROUP, INC.

BORING NO. P8
PAGE 1 OF 1

PROJECT NO. 512-001.1A

LOGGED BY: M.M.

DRILLER: VIRONEX

DRILLING METHOD: GEOPROBE

SAMPLING METHOD: CONT. CORE

CASING TYPE: NA

SLOT SIZE: NA

WELL PACK: NA

CLIENT: TOSCO

DATE DRILLED: 8-21-97

LOCATION: BREMERTON, WA

HOLE DIAMETER: 2"

HOLE DEPTH: 11'

WELL DIAMETER: NA

WELL DEPTH: NA

CASING STICKUP: NA

WELL
COMPLETIONMOISTURE
CONTENT

PID

PENETRATION
(BLOWS/FT)DEPTH
(FEET)RECOVERY
SAMPLE INTERVAL

GRAPHIC

SOIL TYPE

LITHOLOGY / REMARKS

Concrete

Backfilled
with
Bentonite

Dp

0

Dp

0

Mst

0

1

2

3

4

5

6

* 7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

SC

CL

SC

CL

GRAVEL SURFACE

CLAYEY SAND: fill; olive gray; 20% fines; very fine to fine sand; trace to 5% medium to coarse sand; trace gravel; no hydrocarbon odor.

CLAY: olive gray; low plasticity; trace very fine sand; iron oxide staining; no hydrocarbon odor.

CLAYEY SAND: olive gray; 30% fines; very fine sand; trace fine to coarse sand; iron oxide staining; no hydrocarbon odor.

CLAY: olive gray; low plasticity; 10% very fine sand; abundant iron oxide staining; no hydrocarbon odor.

BOTTOM OF BORING 11'

REGIONAL BORING LOGS

File Original and First Copy with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

Application No.

STATE OF WASHINGTON

Permit No. _____

(b) (6)

(1) OWNER: Name...

(b) (6)

(2) LOCATION OF WELL: County Kitsap - NE 1/4 SW 1/4 Sec. 10 T. 34 N. R. 1E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well
(if more than one).....

New well	<input checked="" type="checkbox"/>	Method: Dug	<input type="checkbox"/>	Bored	<input type="checkbox"/>
Deepened	<input type="checkbox"/>	Cable	<input checked="" type="checkbox"/>	Driven	<input type="checkbox"/>
Reconditioned	<input type="checkbox"/>	Rotary	<input type="checkbox"/>	Jetted	<input type="checkbox"/>

(5) **DIMENSIONS:** Diameter of well . . . 6 . . . inches.
 Drilled . . . 60 . . . ft. Depth of completed well . . . 60 . . . ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 60 ft.
 Threaded ☐ " Diam. from " ft. to " ft.
 Welded ☐ " Diam. from " ft. to " ft.

Perforations: Yes ☐ No ☒

Type of perforator used.....

SIZE of perforations in. by in.

..... perforations from ft. to ft.

..... perforations from ft. to ft.

..... perforations from ft. to ft.

Screens: Yes ☐ No ☒

Manufacturer's Name.....

Type..... Model No.....

Diam..... Slot size..... from..... ft. to..... ft.

Diam..... Slot size..... from..... ft. to..... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal _____
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name: Sta-Rite
Type: Sub HP 1

(8) **WATER LEVELS:** Land-surface elevation above mean sea level... 100 ft.
 Static level 30 ft. below top of well Date.....
 Artesian pressure lbs. per square inch Date.....
 Artesian water is controlled by..... (Cap. valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☒ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Yield:	gal./min. with	ft. drawdown after	hrs.
"	10	10	45
"	10	10	45

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
00:00	0.00	00:00	0.00	00:00	0.00
00:05	0.05	00:05	0.05	00:05	0.05
00:10	0.10	00:10	0.10	00:10	0.10
00:15	0.15	00:15	0.15	00:15	0.15
00:20	0.20	00:20	0.20	00:20	0.20
00:25	0.25	00:25	0.25	00:25	0.25
00:30	0.30	00:30	0.30	00:30	0.30
00:35	0.35	00:35	0.35	00:35	0.35
00:40	0.40	00:40	0.40	00:40	0.40
00:45	0.45	00:45	0.45	00:45	0.45
00:50	0.50	00:50	0.50	00:50	0.50
00:55	0.55	00:55	0.55	00:55	0.55
01:00	0.60	01:00	0.60	01:00	0.60
01:05	0.65	01:05	0.65	01:05	0.65
01:10	0.70	01:10	0.70	01:10	0.70
01:15	0.75	01:15	0.75	01:15	0.75
01:20	0.80	01:20	0.80	01:20	0.80
01:25	0.85	01:25	0.85	01:25	0.85
01:30	0.90	01:30	0.90	01:30	0.90
01:35	0.95	01:35	0.95	01:35	0.95
01:40	1.00	01:40	1.00	01:40	1.00
01:45	1.05	01:45	1.05	01:45	1.05
01:50	1.10	01:50	1.10	01:50	1.10
01:55	1.15	01:55	1.15	01:55	1.15
02:00	1.20	02:00	1.20	02:00	1.20
02:05	1.25	02:05	1.25	02:05	1.25
02:10	1.30	02:10	1.30	02:10	1.30
02:15	1.35	02:15	1.35	02:15	1.35
02:20	1.40	02:20	1.40	02:20	1.40
02:25	1.45	02:25	1.45	02:25	1.45
02:30	1.50	02:30	1.50	02:30	1.50
02:35	1.55	02:35	1.55	02:35	1.55
02:40	1.60	02:40	1.60	02:40	1.60
02:45	1.65	02:45	1.65	02:45	1.65
02:50	1.70	02:50	1.70	02:50	1.70
02:55	1.75	02:55	1.75	02:55	1.75
03:00	1.80	03:00	1.80	03:00	1.80
03:05	1.85	03:05	1.85	03:05	1.85
03:10	1.90	03:10	1.90	03:10	1.90
03:15	1.95	03:15	1.95	03:15	1.95
03:20	2.00	03:20	2.00	03:20	2.00
03:25	2.05	03:25	2.05	03:25	2.05
03:30	2.10	03:30	2.10	03:30	2.10
03:35	2.15	03:35	2.15	03:35	2.15
03:40	2.20	03:40	2.20	03:40	2.20
03:45	2.25	03:45	2.25	03:45	2.25
03:50	2.30	03:50	2.30	03:50	2.30
03:55	2.35	03:55	2.35	03:55	2.35
04:00	2.40	04:00	2.40	04:00	2.40
04:05	2.45	04:05	2.45	04:05	2.45
04:10	2.50	04:10	2.50	04:10	2.50
04:15	2.55	04:15	2.55	04:15	2.55
04:20	2.60	04:20	2.60	04:20	2.60
04:25	2.65	04:25	2.65	04:25	2.65
04:30	2.70	04:30	2.70	04:30	2.70
04:35	2.75	04:35	2.75	04:35	2.75
04:40	2.80	04:40	2.80	04:40	2.80
04:45	2.85	04:45	2		

Date of test
 Bailor test 16 gal./min. with 20 ft. drawdown after 2 hrs
 Artesian flow g.p.m. Date
 Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Hard pan	0	10
Gravel Brown Clay	10	22
Hard pan	22	40
Blue Sand and water	40	46
Pea gravel and Sand, Rock	46	60

Work started 7-28 1980 Completed 8-1 1980

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Minter Creek Drilling
(Person, firm, or corporation) (Type or print)

Address 14481 Clayton RD.

Per T. Grady was h 982
[Signed] _____

License No. 1090 .. Date 8-1 .., 1980

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.



Washington State
Department of Transportation

367430

LOG OF TEST BORING

Start Card R-77288

Job No. OL-2829 SR 303 Elevation ft

HOLE No. H-1p-10

Sheet 1 of 3

Project Manette Bridge 303/4A Replacement

Driller Haller, Robert Lic# 2779

Site Address Vicinity of Wheaton Way (SR-303) and Harkins St.

Inspector Fetterly, Jamie #2507 JCF

Start February 19, 2010 Completion February 19, 2010 Well ID# BBN-917

Equipment CME 45 (9C4-3) - AH

Station Offset Hole Dia 5
(inches)

Method Wet Rotary

Northing Easting Collected by HQ Geotech Division

Datum

County Kitsap

Subsection NE1/4 of SE1/4

Section 11

Range 1 EWM

Township 24 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) Moisture Content RQD	Blows/6" (N) and/or RQD FF	Sample Type Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			20 40 60 80						
5				3 2 3 5 (5)	D-1		Well graded SAND with gravel, stratified with silty sand, loose, brown, moist, stratified, HCl not tested. Length Recovered: 0.7 ft. Length Retained: 0.7 ft.		
				7 10 12 15 (22)	D-2		Silty SAND, medium dense, yellowish brown, moist, homogenous, HCl not tested. Length Recovered: 1.7 ft. Length Retained: 1.7 ft.		
10				8 11 15 22 (26)	D-3		Silty SAND, dense, olive gray, moist, homogenous, HCl not tested. Length Recovered: 1.7 ft. Length Retained: 1.7 ft.		
				11 15 17 18 (32)	D-4		Silty SAND, with trace gravel, dense, olive gray, wet, homogenous, HCl not tested. Length Recovered: 1.7 ft. Length Retained: 1.7 ft. gravel contact		
15				>> 25 50/5" (REF)	D-5		Silty GRAVEL with sand, sub-rounded, very dense, olive gray, wet, homogenous, HCl not tested. Length Recovered: 0.9 ft. Length Retained: 0.9 ft.		
				>> 50/5" (REF)	D-6		Silty GRAVEL with sand, sub-rounded, very dense, olive gray, wet, homogenous, HCl not tested. Length Recovered: 0.4 ft. Length Retained: 0.4 ft.		
20				>> 32 50/5"	D-7		Silty SAND with gravel, very dense, gray, moist, homogenous, HCl not tested.		

RECEIVED

FEB 25 2010

Dept of Ecology
WR-NWRO



Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-77288

Job No. OL-2829

SR 303

Elevation ft

HOLE No. H-1p-10

Sheet 2 of 3

Project Manette Bridge 303/4A Replacement

Driller Haller, Robert

Lic# 2779

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) Moisture Content RQD	Blows/ft (N) and/or RQD FF	Sample Type Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			20 40 60 80	(REF)			Length Recovered: 0.9 ft. Length Retained: 0.9 ft.		
				>> 3250/5" (REF)	D-8		Silty SAND, very dense, gray, moist, homogenous, HCl not tested. Length Recovered: 0.9 ft. Length Retained: 0.9 ft.		
25				26 43 50 (93)	D-9		Silty SAND, very dense, gray, moist, homogenous, HCl not tested. Length Recovered: 1.5 ft. Length Retained: 1.5 ft. 2/19/2010		
							major gravel contact		
30				>> 50/3" (REF)	D-10		No Recovery		
35				>> 33 "50/3" (REF)	D-11		Silty SAND with gravel, very dense, gray, wet, homogenous, HCl not tested. Length Recovered: 0.8 ft. Length Retained: 0.8 ft.		
40				>> 50/5" (REF)	D-12		Silty SAND with gravel, very dense, gray, moist, homogenous, HCl not tested. Length Recovered: 0.2 ft. Length Retained: 0.2 ft.		
45				>> 50/3" (REF)	D-13		Silty GRAVEL with sand, sub-rounded, very dense, gray, wet, homogenous, HCl not tested.		



Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-77288

Job No OL-2829

SR 303

Elevation ft

HOLE No H-1p-10

Sheet 3 of 3

Project Manette Bridge 303/4A Replacement

Driller Haller, Robert

Lic# 2779

Depth (ft)	Elevation (ft)	Profile	Field SPT (N)				Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
											Length Recovered:0.3 ft. Length Retained:0.3 ft.		
50							>> 50/5" (REF)		D-14		Silty GRAVEL with sand, sub-rounded, very dense, gray, wet, homogenous. HCl not tested. Length Recovered:0.2 ft. Length Retained:0.2 ft. A standpipe monument was installed on this boring.		
55											The implied accuracy of the borehole location information displayed on this boring log is typically sub-meter in (X,Y) when collected by the HQ Geotech Division and sub-centimeter in (X,Y,Z) when collected by the Region Survey Crew."		
60											End of test hole boring at 49.4 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Note: REF = SPT Refusal		
65											Bail/Recharge test: Hole Diameter: 5 Depth of boring during bail test: 49.4' Depth of casing during bail test: 49' Bailed bore hole water level to 43.9' Recharge after 1 minutes :43' Recharge after 2 minutes :41.6' Recharge after 3 minutes :40.5' Recharge after 4 minutes :39' Recharge after 5 minutes :37.8' Recharge after 10 minutes :33.7'		
70													

24-1E-11J

Please print, sign and return to the Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. 530321

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission ("x" in box)

- ☒ Construction
☐ Decommission

ORIGINAL INSTALLATION Notice of Intent Number:

Consulting Firm Landon Assoc.

Unique Ecology Well IDTag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee JEAN DAVIES
 Name (Print Last, First Name)
 Driller/Engineer/Trainee Signature [Signature]
 Driller or Trainee License No. 1543

If trainee, licensed driller's Signature and License Number:

Type of Well ("x" in box)

- ☐ Resource Protection
☒ Geotech Soil Boring

Property Owner CFA Properties

Site Address 523 Lebo Blvd

City Bremerton County KITSAP

Location NE 1/4-1/4 SE 1/4 Sec 11 Twn 24N R 1

EWM ☒ or WWM ☐

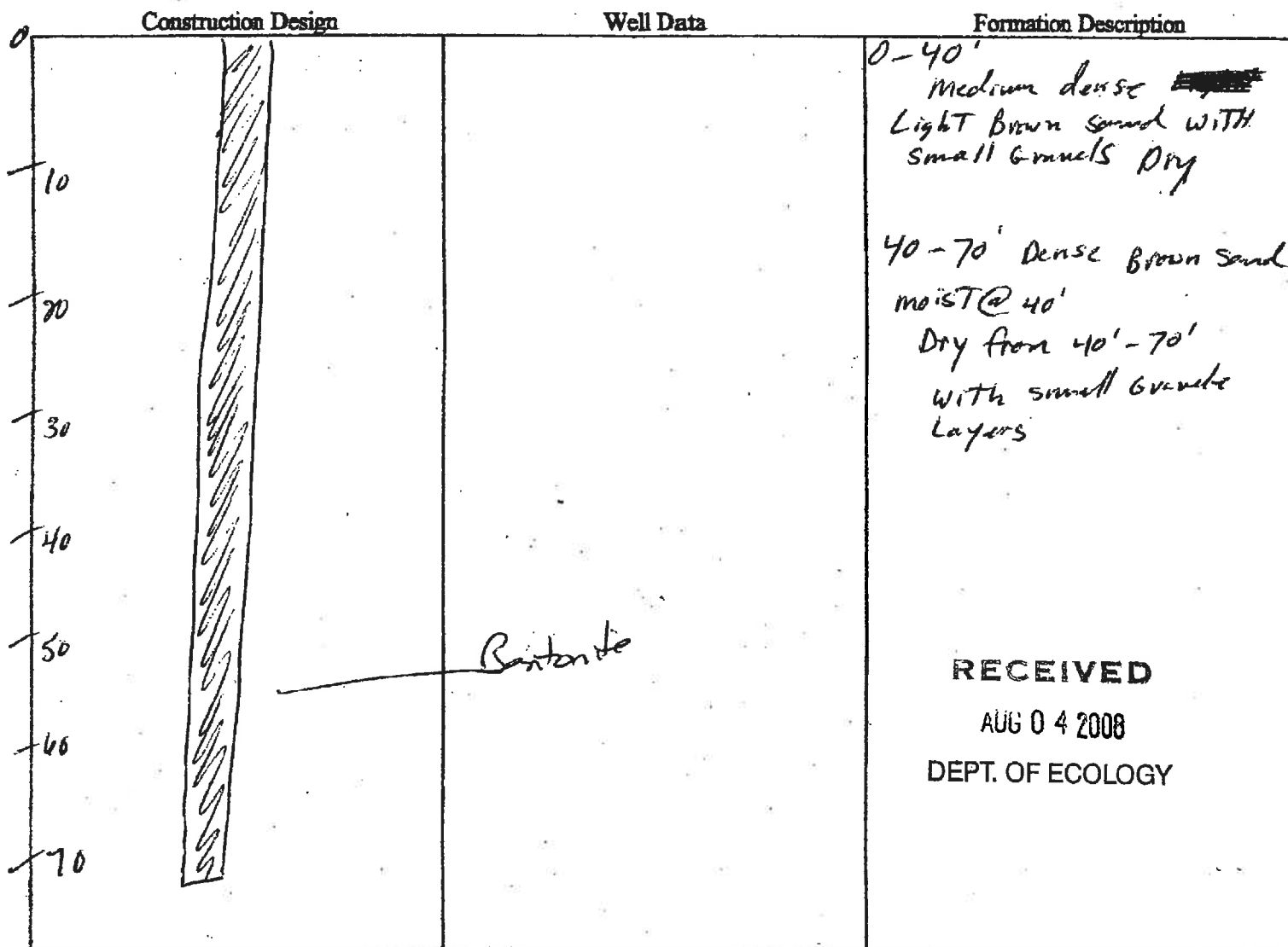
Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Min _____ Sec _____
 Long Deg _____ Min _____ Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 7" Static Level _____

Work/Decommission Start Date 5-2-08

Work/Decommission Completed Date 5-2-08



RECEIVED

AUG 04 2008

DEPT. OF ECOLOGY

12E2

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION

WELL SCHEDULE

No 24 / 1E - 12E2

Date _____ 19 _____

Record by DM

Source _____

Location State of WASHINGTON

County Kitsap

Area _____

Map _____

$\frac{1}{4}$ sec _____ T _____ N R _____ E _____ W

Details _____

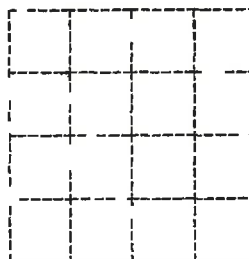


DIAGRAM OF SECTION

Owner City of Bremerton (His No _____)

Address Intl H2O Supply Ltd

Driller _____ Address _____

Topography _____

Land surface datum 260 ft above _____ below _____

Type Dug Drilled Driven _____ Depth Rept 914 feet

Bored Jetted _____ Meas _____ feet

Date _____ 19 42

Casing Diam 8 to _____ in _____ Type _____

Depth _____ ft Finish _____

Chief aquifer _____ Depth _____ ft Thick _____ ft

Water level Rept 23 ft 11-30 19 42 above _____ below _____

Meas _____ which is _____ ft above datum below _____

Pump Type _____ Capacity _____ gal min _____

Driven by _____ horsepower _____

Yield Flow _____ gal min Pump 25 gal min Meas Rept Est

Drawdown _____ ft after _____ hours pumping _____ gal min

Adequacy permanence _____

Use Dom Stock PS RR Ind Irr Obs _____

Quality Sample No _____ 19 _____ Temp 46 F

Taste color hardness sanitation etc _____

Other data Log Water levels Draft Pump test Analyses _____

Tu n up

P 1 52

25597

RESOURCE PROTECTION WELL REPORT

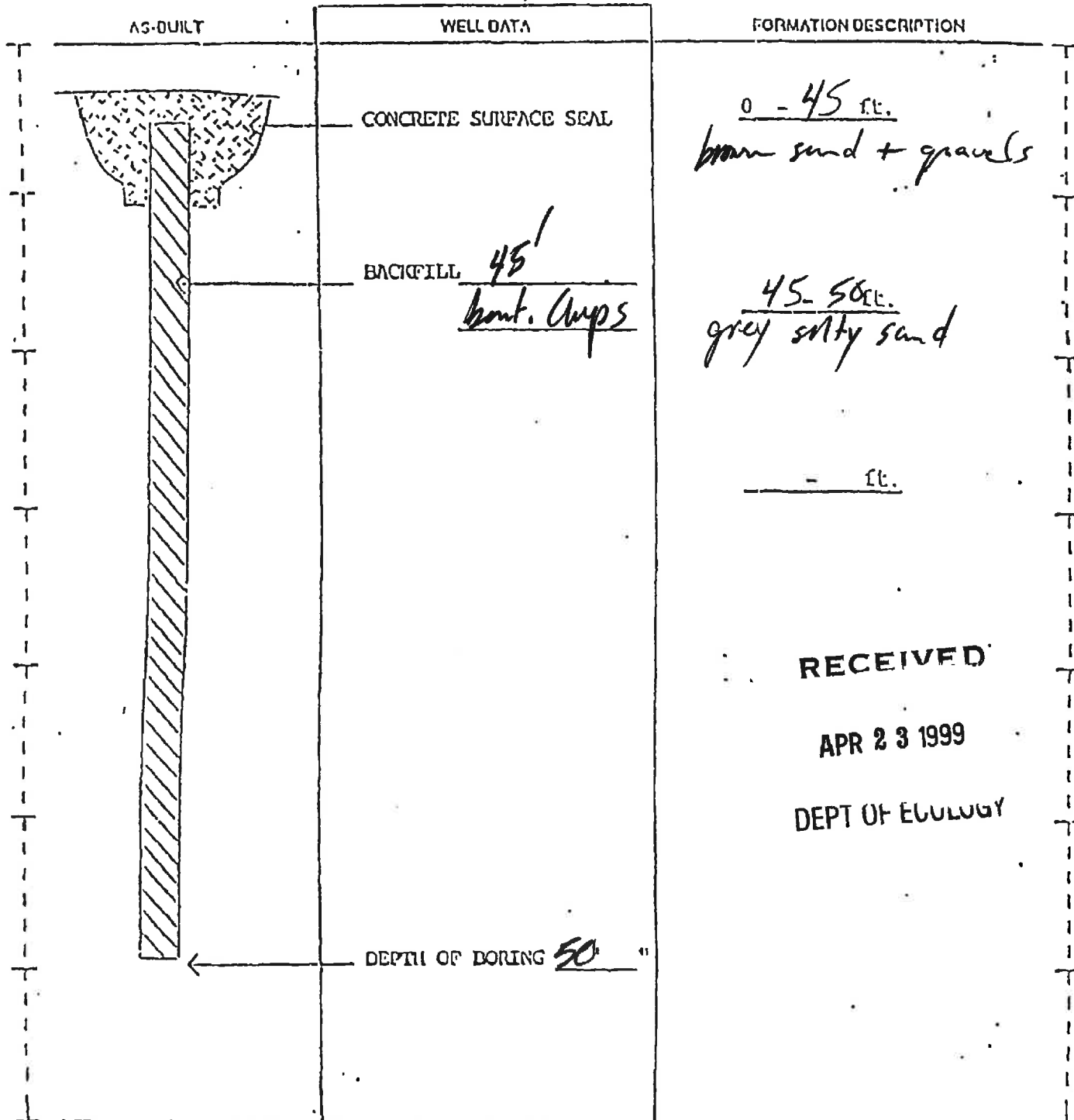
ENTERED

START CASE NO. 304058

PROJECT NAME: Harrison Medical Cntr
 WELL IDENTIFICATION NO. n/a
 DRILLING METHOD: HSA
 DRILLER: Brian Gose
 FIRM: Cascade Drilling, Inc.
 SIGNATURE: [Signature]
 CONSULTING FIRM: Shannon & Wilson
 REPRESENTATIVE: Martin Page

COUNTY: Kitsap 24-1E-12L
 LOCATION: NE 1/4 Sec 12 T24N R1E
 STREET ADDRESS OF WELL: 2520 Cherry Ave. - Bremerton
 WATER LEVEL ELEVATION: N/A
 GROUND SURFACE ELEVATION: N/A
 INSTALLED: 9/5/97
 DEVELOPED: N/A

9159



RECEIVED

APR 23 1999

DEPT OF ECOLOGY

106374

24-1E-12M

RESOURCE PROTECTION WELL REPORT

START CARD NO. 57808

PROJECT NAME: Harrison Memorial Hosp.
 WELL IDENTIFICATION NO.
 DRILLING METHOD Hollow Stem Auger
 DRILLER: Artesian Mechanical
 FIRM: Geo Tech Explorations, Inc.
 SIGNATURE: Artesian Mechanical
 CONSULTING FIRM: Markin Page
 REPRESENTATIVE: Shannon & Wilson

COUNTY: Kitsap
 LOCATION: NW 1/4 SD 1/4 Sec 12 Twn 24N R 1E
 STREET ADDRESS OF WELL: 2520 Cherry Ave
 WATER LEVEL ELEVATION:
 GROUND SURFACE ELEVATION:
 INSTALLED: 12-4-01
 DEVELOPED:

RECEIVED

DEC 31 2001

AS-BUILT	WELL DATA	FORMATION DESCRIPTION
	Concrete Surface Seal FM 0 ft. To 1 ft.	
	Borehole Diameter: <u>8</u> in.	0 ft. to <u>50</u> ft. <u>Silty Gravel</u>
	Seal: Material: <u>Bent.</u> From <u>0</u> ft. To <u>50</u> ft. Amount: <u>25 bags</u>	<u> </u> ft. to <u> </u> ft.
		<u> </u> ft. to <u> </u> ft.
		<u> </u> ft. to <u> </u> ft.
	Depth of Well <u>50</u> ft.	Number of Boreholes/Abandonment Completed The Same: <u>87</u>

SCALE: 1" =

PAGE OF

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No.

RE07123

Construction/Decommission

☒ Construction 453894
☐ Decommission ORIGINAL INSTALLATION Notice
of Intent Number _____

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

BREMERTON HOUSING AUTHORITY

Consulting Firm LANDAU ASSOCIATES

Property Owner

Site Address

600 OYSEY BAY AVENUE

City

BREMERTON

County

KITSAP

Unique Ecology Well ID

Tag No.

BCK 048

Location

1/4 SW 1/4 NW Sec 15 Twn 24N R 1E or WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards

Materials used and the information reported above are true to my best knowledge and belief

Lat/Long (s,t,r

Lat Deg

Lat Min/Sec

still Required)

Long Deg

Long Min/Sec

Tax Parcel No.

Cased or Uncased Diameter

Static Level 63'

Work/Decommission Start Date

5/21/12

Work/Decommission End Date

5/22/12

☐ Driller ☐ Trainee Name (Print)

Steve Zimmerman

Driller/Trainee Signature

[Signature]

Driller/Trainee License No.

2915

If trainee, licensed drillers'

Signature and License No.

Construction/Design

Well Data

Formation Description

	Concrete Surface Seal	Depth	<u>1.5</u> FT	<u>0 - 15</u> FT <u>Blast sand</u> <u>Debris</u> <u>15-57</u> <u>Silty Gravel</u> <u>57-6' perc sit</u> <u>61-71</u> FT <u>Sandy some site</u> <u>Light Gravel</u> <u>71-80</u> <u>Sandy Gravel</u> <u>0 -</u> FT
	Blank Casing (dia x dep)	<u>2" 0-68 1/2</u>		
	Material	<u>PVC</u>		
	Backfill	_____ FT		
	Type	_____		
	Seal	<u>1.5 66</u>		
	Material	<u>Dentonite Chip</u>		
	Gravel Pack	<u>66-78.5</u> FT		
	Material	<u>10/20 CSSI</u>		
	Screen (dia x dep)	<u>2" 68.5-78.5</u>		
Slot Size	<u>1020</u>			
Material	<u>PVC</u>			
Well Depth	<u>78.5</u> FT			
Backfill	_____			
Material	<u>Slough</u>			
Total Hole Depth	<u>80</u> FT			

RECEIVED

JUN 11 2012

WA State Department
of Ecology (SWRO)

24-12-15L

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No. SE09302

Construction/Decommission

☒ Construction

☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number 410255

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Consulting Firm CRA Conestoga-Rovers & Associates

Unique Ecology Well ID

Tag No. _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington Well construction standards.

Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Trainee Name (Print) David Gose

Driller/Trainee Signature _____

Driller/Trainee License No. 2744

If trainee, licensed drillers'

Signature and License No. _____

Property Owner Shell

Site Address 3800 Kitsap Way

City Bremerton

County 18-Kitsap

Location 1/4 NE 1/4 SW Sec 15 Town 24N R1E

EWM

WWW

Lat/Long: (s, t, r) Lat Deg x Lat Min/Sec x

still Required) Long Deg x Long Min/Sec x

Tax Parcel No. 152401-3-177-2001

Cased or Uncased Diameter 8 1/2

Static Level _____

Work/Decommission Start Date 3/16/2011

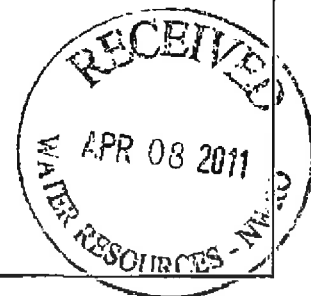
Work/Decommission Completed Date 3/17/2011

Construction/Design

Well Data W11-126B

Formation Description

	CONCRETE SURFACE SEAL	<u>5</u> FT	<u>0 - 5'</u> FT
	BACKFILL	<u>35</u> FT	<u>0 - 5.40'</u> FT
		<u>H40 BENT</u>	<u>brown silty sands and gravels</u>
	DEPTH OF BORING	<u>40</u> FT	<u>0 -</u> FT



Scale 1" = _____

Page _____ of _____

ECY 030-12 (Rev. 2011)



DEPARTMENT OF
ECOLOGY
State of Washington

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle)

☒ Construction

☐ Decommission **ORIGINAL INSTALLATION**

Notice of Intent Number

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal
☐ DeWater ☐ Irrigation ☐ Test Well ☒ Other **GEQ**

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Reconditioned Method: ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 100 ft.
 Depth of completed well 100 ft.

CONSTRUCTION DETAILS
 Casing ☐ Welded _____" Diam. from _____ ft. to _____ ft.
 Installed: ☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
 Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 100 ft.
 Material used in seal Super Grout

Did any strata contain unusable water? ☐ Yes ☒ No
 Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____
 Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level _____ ft. below top of well Date _____
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap. valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
 Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Josh Kocop

Driller/Engineer/Trainee Signature [Signature]

Driller or trainee License No. 2874

IF TRAINEE: Driller's License No:

Driller's Signature: _____

CURRENT

Notice of Intent No. GE00244

Unique Ecology Well ID Tag No. BCR679

Water Right Permit No. _____

Property Owner Name (b) (6)

Well Street Address 1333 Lafayette Ave N

City Bremerton County Kitsap

Location SW1/4-1/4 NE1/4 Sec 15 Twn 24N R 1E

(s, t, r Still REQUIRED)

EWM ☒

Or

WWM ☐

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 37740090070002

CONSTRUCTION OR DECOMMISSION PROCEDURE
 Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown fine to medium sand	0	
loose		4
Brown silty clay	4	11
Small to medium multicolored	11	
gravel, fine brown sand loose		29
Blue silt, soft	29	48
Brown silty clay with lenses	48	
of gravel		65
Brown silty clay	65	74
Brown silty sand and gravel	74	81
Brown silty clay, stiff, dry	81	98
Small to medium gravel	98	
cobbles, with fine brown		
sand and silt		100
Installed 3/8 X 1/4 copper		
loop and grouted from bottom		
to land surface with		
Super Grout		
	111	
	JUN - 8	
	11:07	

Start Date 06/01/2011 Completed Date 06/01/2011

File Original and First Copy with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. _____

Permit No. _____

(b) (6) _____ Address _____ (b) (6)

(1) OWNER: Name _____

(2) LOCATION OF WELL: County Kitsap - NW 1/4 Sec 15 T 24 N. R 1 E W.M.
Bearing and distance from section or subdivision corner Maybe 1W

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 6 ft. Depth of completed well 201 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 201 ft.
Threaded ☐ " Diam. from _____ ft. to _____ ft.
Welded ☐ " Diam. from _____ ft. to _____ ft.

Perforations: Yes ☐ No ☒
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type ST Model No. _____
Diam. 3" Slot size 10 from 191 ft. to 201 ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Bent
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____ HP _____
Type: _____

(8) WATER LEVELS: Land-surface elevation 350 ft.
Static level 150 ft. below top of well Date 9-20-81
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " " " "
" " " " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

Date of test _____
Baller test 9 gal./min. with 70 ft. drawdown after 2.0 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	4
Hardpan med.	4	41
Clay and sand	41	64
Pea gravel some clay	64	66
Sandy clay	66	76
Blue clay	76	99
Hard pan	99	131
Wet sand	131	163
Hard pan	163	181
Dirty sand little water	181	201

RECEIVED
JAN 27 1987
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

Work started 9-20, 1981/Completed 9-20, 1981

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
NAME Water Creek Drilling (Type or print)
(Person, firm, or corporation)
Address 14400 Blanton RD PO
[Signed] Earl Paul (Well Driller)
License No. 1092 Date 8-11, 1986

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.

Permit No.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(1) OWNER: Name (b) (6) Address (b) (6) Bremerton

(2) LOCATION OF WELL: County Kitsap - NE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 16 T. 24 N. R. 1 E. W.M.

Bearing and distance from section or subdivision corner Kitsap

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

New well	<input checked="" type="checkbox"/>	Method: Dug	<input type="checkbox"/>	Bored	<input type="checkbox"/>
Deepened	<input type="checkbox"/>	Cable	<input checked="" type="checkbox"/>	Driven	<input type="checkbox"/>
Reconditioned	<input type="checkbox"/>	Rotary	<input type="checkbox"/>	Jetted	<input type="checkbox"/>

(5) **DIMENSIONS:** Diameter of well 6 inches.
 Drilled .. 295 ft. Depth of completed well..... 8770-219 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 295 ft.
 Threaded ☐ " Diam. from ft. to ft.
 Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒

Type of perforator used.....

SIZE of perforations in. by in.

..... perforations from ft. to ft.

..... perforations from ft. to ft.

..... perforations from ft. to ft.

Screens: Yes ☐ No ☒

Manufacturer's Name.....
Type..... **Model No.**.....
Diam...... **Slot size**..... **from**..... **ft. to**..... **ft**
Diam...... **Slot size**..... **from**..... **ft. to**..... **ft**

Gravel packed: Yes ☐ No ☒ Size of gravel: _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) **PUMP:** Manufacturer's Name _____
Type: _____ **HP** _____

(8) WATER LEVELS: Land-surface elevation ft.
above mean sea level.
Static level 276 ft. below top of well Date 6-30-79
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap. valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☒ If yes, by whom?

Yield: gal./min. with _____ ft. drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off) (water level
measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
.....
.....

Date of test _____
 Bailor test... 8 gal./min. with 19 ft. drawdown after 1 hr.
 Artesian flow... _____ g.p.m. Date... _____
 Temperature of water... _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Topsoil	0	2
Gray conglomerate	2	78
Sand & gravel	78	145
Brown conglomerate	145	248
Sand & gravel	248	259
Muddy sand	259	280
Silty sand & water	280	290
Sand & water	290	293
Sand & gravel and water	293	295

Work started June 13 19 79 Completed June 30 19 79

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Tyco Wall Drilling Co., Inc.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 30, Allyn, Wa. 98524

[Signed] _____

License No. 0967 Date June 30, 1979

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No.

24-1E-160R
SE04761

Construction/Decommission

☒ Construction

☐ Decommission ORIGINAL INSTALLATION Notice

of Intent Number

349095

Type of Well

☐ Resource Protection

☒ Geotechnical Soil Boring

Property Owner

Site Address

City

County

GOLD LAWNELL

76 RUSSEL Rd

BREMERSTON

KITSAP

Location

1/4 SE 1/4 SE Sec 16 Twn 24N R 1E

(EWM)

WWM

Lat/Long (s,t,r

Lat Deg

Lat Min/Sec

still Required) Long Deg

Long Min/Sec

Tax Parcel No.

Cased or Uncased Diameter

8"

Static Level N/A

Work/Decommission Start Date

6-11-09

Work/Decommission Completed Date

6-11-09

Consulting Firm AESI

Unique Ecology Well ID

Tag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards

Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Trainee Name (Print)

Andrew Flagan

Driller/Trainee Signature

Driller/Trainee License No.

2761

If trainee, licensed drillers'

Signature and License No.

Construction/Design

Well Data W09-291

Formation Description

	<p>CONCRETE SURFACE SEAL</p> <p>8' FT</p>	<p>0 - 70' FT</p> <p>brown silty sand & gravel</p>
	<p>BACKFILL</p> <p>77'</p> <p>bent chips</p>	<p>70' - 85' FT</p> <p>brown silty sand - outwash - gravels</p>
	<p>DEPTH OF BORING</p> <p>85' FT</p>	<p>- FT</p>

RECEIVED

JUL 14 2009

Dept of Ecology

WR-NWRO

Scale 1" =

Page of

ECY 050-12 (Rev-v 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No.

24-1E-160R
SE04761

Construction/Decommission

☒ Construction

☐ Decommission ORIGINAL INSTALLATION Notice
of Intent Number

349094

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Consulting Firm Associated Earth Sciences-Kirkland

Unique Ecology Well ID

Tag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards

Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Trainee Name (Print) Andy Flagan

Driller/Trainee Signature

Driller/Trainee License No. 2761

If trainee, licensed drillers'

Signature and License No.

Property Owner Old Landfill

Site Address 76 Russel Rd.

City Bremerton

County 18-Kitsap

Location 1/4 SE 1/4 SE Sec 16 Town 24N R1E

EWM
or
WWM

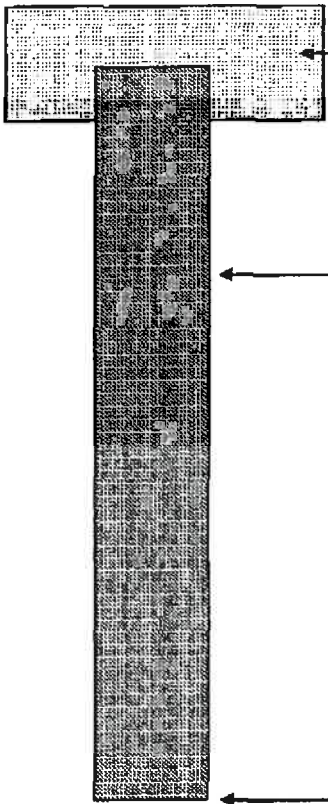
Lat/Long (s, l, r) Lat Deg x Lat Min/Sec x
still Required) Long Deg x Long Min/Sec x

Tax Parcel No.

Cased or Uncased Diameter 8" Static Level

Work/Decommission Start Date 6-9-09

Work/Decommission Completed Date 6-8-09

Construction/Design	Well Data W09-291	Formation Description
	CONCRETE SURFACE SEAL 4' FT	0 - 20' FT brown sandy fill
	BACKFILL 47.5' FT bent chips	0 20- 30' FT grey sandy silt
	DEPTH OF BORING 51.5' FT	0 30' 37' FT peat 37'-51.5' grey silty sands

Scale 1" =

Page of

ECV 050-12 (Rev-v 2/01)

RECEIVED

JUL 14 2009

Dept of Ecology
WR-NWRO

Well ID# Geotech Soil Boring
Start Card # SE02712

(1) OWNER/PROJECT _____ WELL NO. _____
 Name City of Bremerton
 Address 3450 6th St
 City Bremerton State WA Zip 98337

(6) LOCATION OF WELL By legal description:
 County Kitsap Latitude _____ Longitude _____
 Township 24N (N or S) Range 1E (E or W) Section 16
SE 1/4 of SE 1/4 of above section.
 Street address of well location Oyster Bay Rd @
Kitsap way Brimnatch WA
 Tax lot number of well location N/A

(2) TYPE OF WORK

☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☒ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☒ Hollow Stein Auger ☐ Other _____

(7) STATIC WATER LEVEL:

_____ Ft. below land surface. Date _____

Artesian Pressure _____ lb./sq. in. Date _____

(4) BORE HOLE CONSTRUCTION:

Special Standards ☐ Yes ☒ No Depth of Completed Well 51.5 ft

(8) WATER BEARING ZONES:

Depth at which water was first found _____

From	To	Est. Flow Rate	SWL

(9) WELL LOG:

Ground Elevation _____

Material	From	To	SW
fill	0	51.5	

RECEIVED
 SEP 02 2008
 Washington State
 Department of Ecology

Date started 7/2/08 Completed 7/21/08

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Clay Griffith License No. 1850
 Trainee Name Teri Wolfe License No. 2875T
 Drilling Company Holocore Drilling Inc
 (Signed) Clay Griffith License No. 1850
 Address 1062 Todd Rd E Edgewood WA 98372
 Registration No. HOLOCOT044KH Date 8/26/08

(5) WELL TESTS:

☐ Pump ☐ Baller ☐ Air ☐ Flowing AuctionPermeability _____ Yield _____ GPM _____

Conductivity _____ PH _____

Temperature of water _____ OF/C Depth artesian flow found _____ ft.

Was water analysis done? ☐ Yes ☒ No

By whom?

Depth of strata to be analyzed. From _____ ft. to _____ ft.

Remarks

Name Of Supervising Geologist/Engineer Lambert

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No.

241E-22C
S 24580

Construction/Decommission

☒ Construction

☐ Decommission ORIGINAL INSTALLATION Notice

of Intent Number

197070

Consulting Firm

Perrone Consulting

Unique Ecology Well ID

Tag No.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards

Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Trainee Name (Print)

Driller/Trainee Signature

Driller/Trainee License No.

Frank Scott

[Signature]

2541

If trainee, licensed drillers'

Signature and License No.

Type of Well

☐ Resource Protection

☒ Geotechnical Soil Boring

Property Owner

Habitat for Humanity

Site Address

W. Arsenal Wy + S. Main Av

City

Bremerton

County

Kitsap

Location

1/4 NE 1/4 NW Sec 22 Twn 24N R 1E or FWM

FWM

WWM

Lat/Long (s,t,r Lat Deg

Lat Min/Sec

still Required) Long Deg

Long Min/Sec

Tax Parcel No.

Cased or Uncased Diameter

8"

Static Level

N/A

Work/Decommission Start Date

5/14/04

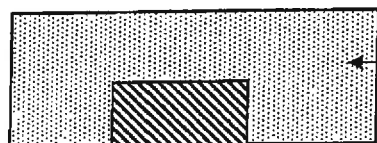
Work/Decommission Completed Date

5/16/06

Construction/Design

Well Data W06-335

Formation Description



CONCRETE SURFACE SEAL

2 FT

BACKFILL

Backfill

RECEIVED

JUN 08 2006

DEPT. OF ECOLOGY

DEPTH OF BORING

55 FT

0 - 50 FT

Fill

50 - 55 FT

Brown silty sand

FT

PROJECT: Crown Hill Elementary W.O. 11-08362-11 WELL NO. MW-1

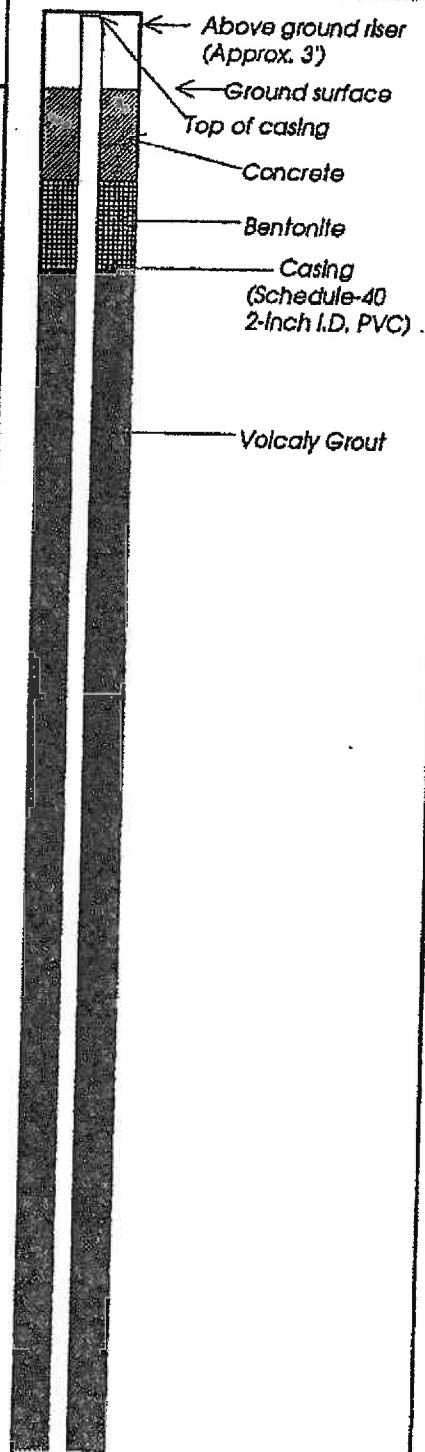
Elevation reference: Not Applicable
Ground surface elevation: 135.96 feet

Well completed: 28 December 1994
Casing elevation: 138.79 feet

AS-BUILT DESIGN

Page 1
of 5

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	QVM READING	GROUND WATER
0	Grass, sand and gravel Fill					
	Loose to medium dense, moist, brown, medium SAND with some silt					
5	Becomes dense and brownish-red		MW1- 5	32	0	
10	Becomes very dense		MW1- 10	56	0	
15	Gravelly SAND (Inferred)					
	Decrease in gravel content (Inferred)	X		50/ 5'		
20	Very dense, moist, brown, medium SAND with gravel and some silt (gravel is approx. 1/8-inch to 1-inch and sub-rounded)		MW1- 20	50/ 4'	0	
25			MW1- 25	50/ 4'	0	
30	(continued)					



TESTING

I 2-inch O.D.
spill-spoon sample

LEGEND

▼ Observed groundwater level
ATD = at time of drilling

X Sample not recovered

EPA 4260
EPA 8270
RCRA Metals

Analytical testing

Ecology ID# ABN 150

▼ Observed groundwater level
6/00/00 6/00/00 = date observed

AGRA
Earth & Environmental

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 27 December 1994

Drilling completed: 28 December 1994

Logged by: JK

PROJECT: Crown Hill Elementary W.O. 11-08362-11 WELL NO. MW-1

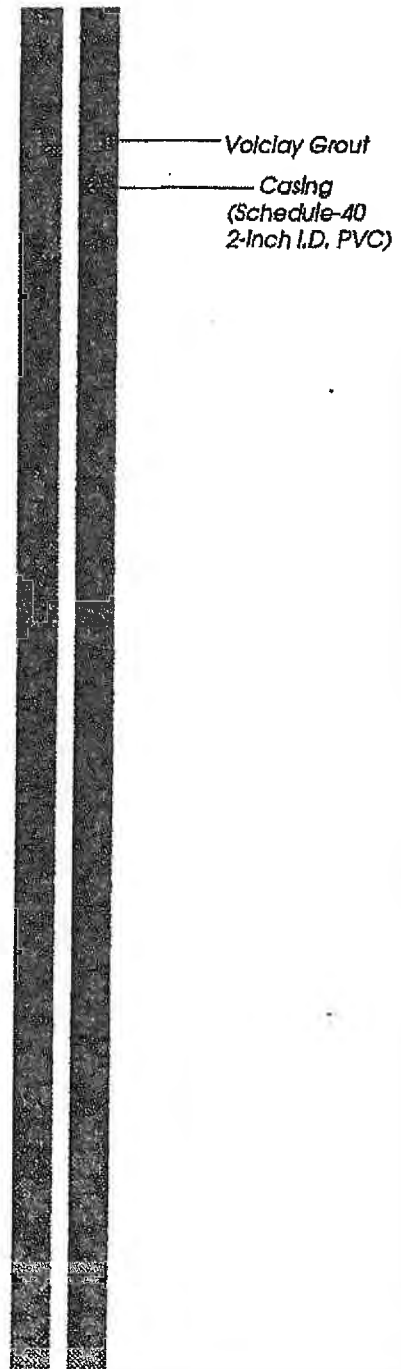
Elevation reference: Not Applicable
Ground surface elevation: 135.96 feet

Well completed: 28 December 1994
Casing elevation: 138.79 feet

AS-BUILT DESIGN

Page 2
of

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	OVM READING	GROUND WATER	TESTING
30	Dense, damp to moist, brown, medium SAND with some gravel and trace to some silt	I	MW1-30	40	0		
35	Gravel content decreases to trace amounts Becomes gravelly (inferred)	I	MW1-35	40	0		
40	Gravelly SAND (inferred); (rock wedged in auger)	X		50/.5'			
45		X		50/.5'			
50	Very dense, damp, brown, medium SAND with gravel and trace to some silt	I	MW1-50	120/6'	0		
55		I	MW1-55	77	0		
60	(continued)						



I 2-Inch O.D. split-spoon sample

▼ Observed groundwater level
ATD = at time of drilling

X Sample not recovered

LEGEND

EPA 8260
EPA 8270
RCRA Metals

Analytical testing

Ecology ID# ABN 150

▼ Observed groundwater level
6/00/00 0/00/00 = date observed

AGRA
Earth & Environmental

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 27 December 1994

Drilling completed: 28 December 1994

Logged by: JK

PROJECT: Crown Hill Elementary W.O. 11-08362-11 WELL NO. MW-1

Elevation reference: Not Applicable
Ground surface elevation: 135.96 feet

Well completed: 28 December 1994
Casing elevation: 138.79 feet

AS-BUILT DESIGN

Page 3
of 5

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	OVM READING	GROUND WATER	TESTING
60							
65	Very dense, damp to moist, brown, medium SAND with trace to some gravel and some silt (gravel less than 1/4-inch, sub-rounded)		MW1-65	71	0		
70							
75	Silt content decreases to trace		MW1-75	50/ 4'	0		
80							
85			MW1-85	50/ 5'	0		
90	(continued)						

Volclay Grout
Casing
(Schedule-40
2-inch I.D. PVC)

2-inch O.D.
split-spoon sample

Observed groundwater level
ATD = at time of drilling

X Sample not recovered

LEGEND

EPA 8260
EPA 8270
RCRA Metals

Analytical testing

Ecology ID# ABN 150

Observed groundwater level
0/00/00 = date observed

AGRA
Earth & Environmental

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 27 December 1994

Drilling completed: 28 December 1994

Logged by: JK

PROJECT: Crown Hill Elementary W.O. 11-08362-11 WELL NO. MW-1

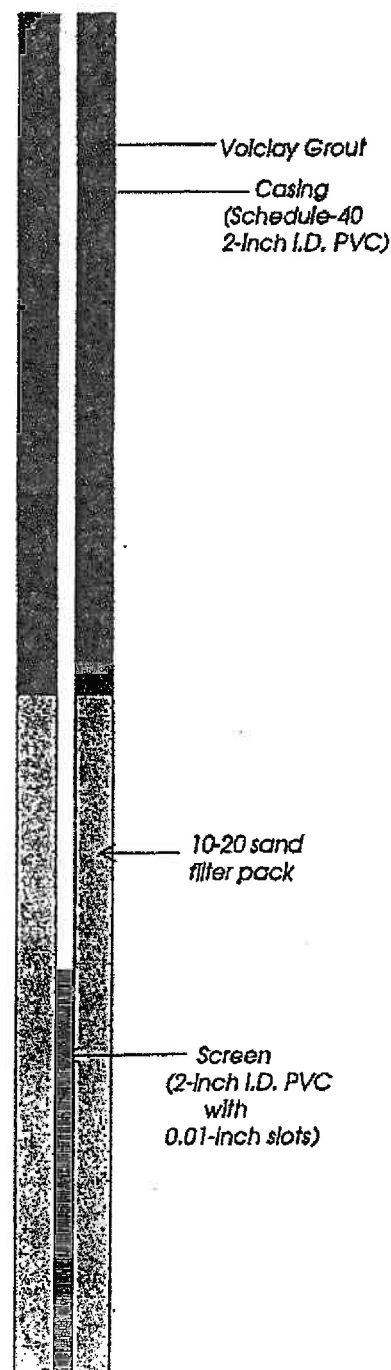
Elevation reference: Not Applicable
Ground surface elevation: 135.96 feet

Well completed: 28 December 1994
Casing elevation: 138.79 feet

AS-BUILT DESIGN

Page 4
of 7

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	QVM READING	GROUND WATER	TESTING
90							
95	Gravel content increases (inferred) Very dense, damp to moist, brown, medium SAND with gravel and trace to some silt (gravel size 1/2-inch to 3/4-inch)		MW1- 95	50/ 5'	0		
100							
105	Very dense, damp to moist, brown, medium SAND with trace gravel and trace silt		MW1- 105	73	0		
	Gravel content increases (inferred)						
110	Gravel content decreases (inferred)						
115			MW1- 115	50/ 5'	0		
120	(continued)						



I 2-inch O.D.
split-spoon sample

▼ Observed groundwater level
ATD = at time of drilling

X Sample not recovered

LEGEND

EPA 8260
EPA 8270
RCRA Metals

Analytical testing

Ecology ID# ABN 150

▼ Observed groundwater level
0/00/00 = date observed

AGRA
Earth & Environmental

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 27 December 1994

Drilling completed: 28 December 1994

Logged by: JK

PROJECT: Crown Hill Elementary W.O. 11-08362-11 WELL NO. MW-1

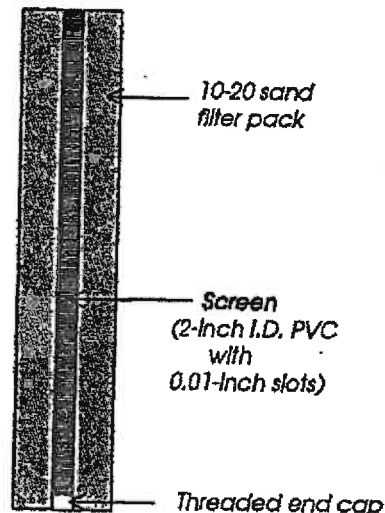
Elevation reference: Not Applicable
Ground surface elevation: 135.96 feet

Well completed: 28 December 1994
Casing elevation: 138.79 feet

AS-BUILT DESIGN

Page 5
of 5

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	OVM READING	GROUND WATER	TESTING
120	Very dense, damp to moist, brown, medium SAND with trace gravel and trace silt						
125	Very dense, wet, brown, medium SAND with trace gravel and some silt		MW1-125	50/6'	0	1/12/95 ATD	
130							
135	Very dense, wet, gray, fine to medium SAND with some silt and trace gravel		MW1-135	50/5'	0		
140			MW1-140	50/5.5'	0		
145	Bottom of boring at 141.5 feet. No unusual odors or staining observed.						
150							



I 2-inch O.D. split-spoon sample

Observed groundwater level
ATD = at time of drilling

X Sample not recovered

LEGEND

EPA 8260
EPA 8270
RCRA Metals

Analytical testing

Ecology ID# ABN 160

Observed groundwater level
0/00/00 = date observed

AGRA
Earth & Environmental
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 27 December 1994

Drilling completed: 28 December 1994

Logged by: JK

SEDIMENT BORING LOGS



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-86-01

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 0935

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: No aliquot taken from location closest to bank due to large amount of rock and shell and no sediment present.

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	0935			Y	4	

Sample Description: SANDY GRAVEL, well-graded (GW), moist, brown, grey, and black. 50% gravel, 30% sand, 20% shell wash.

Sample Containers: 1x 16 oz, 1x 8 oz, 1x 4 oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-02

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1440

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1440			Y	4	

Sample Description:

Surface - Barnacle-covered COBBLE and GRAVEL, well-sorted (GW).
0-2cm - SANDY GRAVEL, well-sorted (GW), ^{not} moist, 70% gravel, 20% sand, 10% shell, brown, moist.
2-4cm - GRAVELLY SAND, well-sorted (SW), damp, moist, black, 85% sand, 10% gravel, 5% shell.
4-10cm - color changes to grey & brown.
8-10cm - CLAY, firm, light grey, damp - location closest to water only.

Sample Containers:

1x16oz, 1x8oz, 1x4oz

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-SG03

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1215

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1215			Y		

Sample Description: GRAVELLY SAND, poorly graded (SP). wet, dark grey.
80% sand, 20% gravelly. Surface covered in shell
wash and gravel. Trace worms.

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-SG04

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CE, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1020

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes: Subsurface aliquots composited from 4 of 5 collection locations
No aliquot taken from location furthest from waters edge.
BLW-RE-SG04B

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1020			Y	4	Center location - @ 7cm - moderate H ₂ S-like odor.
	1030				4-12	

Sample Description: 0-1cm - SHELLY SAND, well-graded (SW). Moist, brown.
60% Sand, 30% Shell, 10% gravel
1-10cm: SAND, well-graded (SW) with gravel, cobble,
and shell. 70% Sand, 15% gravel, 90% shell, 5% cobble.
10cm-1ft. Fine-grain SAND, poorly graded (SP), wet,
grey, moderate to strong H₂S odor. Trace to moderate
rainbow and metallic sheen.

Sample Containers: 2x16oz, 1x8oz, 1x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-S405

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1005

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1005			Y		

Sample Description: 0-3cm - SHELLY SAND, well-graded (sw). Moist, multi-colored, 50% sand, 30% shell, 20% gravel.
3-10cm - GRAVELLY SAND, well-graded (sw). wet, brown 80% sand, 20% gravel. Slight crabs on surface.
small

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-8G-06

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1200

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1200			Y		

Sample Description:

GRAVELLY SAND, well-graded (SW). Moist, grey, with black mottling. 75% sand, 20% gravel, 5% shell. Trace snails.

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BYW-RE-SG-07

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1420

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1420			Y	4	

Sample Description:

GRAVEL on surface.
Surface - 10cm: GRAVELLY SAND (SW), well-graded,
damp, gray and brown. Moderate coal and coal-
like pieces scattered in and around sed. Moderate
algae on surface. 80% sand, 15% gravel, 5% shell.

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-S908

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1400

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes: Duplicate collected at 14:10 - BGW-RE-SG58-130708 (2 jars)

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1400			Y	4	

Sample Description: GRAVELLY SAND, well-graded (SW). Dump. Black and brown 70% sand, 30% gravel. Slight layer of shell on surface with slight dried algae. 0-2 cm - brown, 2-10 cm - black. Trace coal & coke-like pieces.

Sample Containers: 1x16oz, 2x8oz, 2x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: Blyn-RE-SG09

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1140

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1140			Y		

Sample Description:

0-2 cm - shell hash
2-10 cm - GRAVELLY SAND, well-graded, wet, grey and brown. 80% sand, 10% gravel.

Sample Containers: 1x160Z, 1x80Z, 1x40Z

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-10

Job No: 131014-01.01

Date: July 8 2015

Field Staff: Gillingham/Henningsen

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 0953 first aliquot

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	0953			Y 8-4 DPR	0-4	No odor ~10% algae on rocks

Sample Description:

SAND w/ 10% gravel ~ ^{DPR} 5% shell hash
Brown in top 1 inch then gray color
Some rust-colored sand
~10% rubble on surface
Well graded Moist, soft

Sample Containers:

3 jars as noted below

Analyses:

TOC, PAH-SIM, Archive

4oz 8oz 16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG11

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1230

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1230			Y	4	

Sample Description:

GRAVELLY SAND, well graded (SW). Wet, brown and grey. 80% Sand, 15% gravel, 5% Shell hash. Moderate algae on surface.

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-12

Job No: 131014-01.01

Date: July 8, 2015

Field Staff: Gillingham / Hennessey

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1006 First aliquot

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1006			Y	0-4	No odor ~10% Algae on surface

Sample Description:

SAND w/ coarse gravel ~10% gravel, 5% shell hash
Brown color with some gray lenses
Some dark gray lenses ~~But~~ graded - well
No odor
Grades from coarse surface to finer sand
w/ trace silt
Moist, soft

Sample Containers:

3 jars as noted below

Analyses:

TOC, PAH-SIM, Archive

402 802 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG13

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1245

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1245			Y	4	

Sample Description:

GRAVELLY SAND, well graded (SW), wet, brown and grey. 85% sand, 10% gravel, 5% shell hash. Water and moderate algae on surface.

Sample Containers:

1x16oz, 1x8oz, 1x4oz.

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-14

Job No: 131014-01.01

Date: July 8, 2013

Field Staff:

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1019

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1018			Y	0-4	No odor Some Fucus on station

Sample Description:

SAND w/ 15% gravel w/ 10% cobble on surface
endings of rust & 15% shell hash
Brown color, well graded
Moist, soft
Some fucus on station

Sample Containers:

3 as noted below:

Analyses:

TOC, PAH-SIM, Archive

402 802 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-15

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Aillingham/Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 10:47

Dup at 10:52

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes: Very minor hydrocarbon odor in SE aliquot
PID recorded zero throughout

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	10:47				0-4	274 Minor H.C. No odor in SW Aliquot
Dup	10:52				0-4	SG-65
Arch	10:47				4-10	SG-15-B From SE corner

Sample Description:

G#1 Surface covered with gravel +
SAND w/ 10-25% silt - Darker lenses @ 3 inches
Moist. Soft 0ft - Slight odor - Well graded

Arch #B SAND w trace silt Brown color
Moist. Soft No odor Poorly graded

Sample Containers: 4 jars as noted below

Analyses:

TOC, PAH-SIM, Archive

9oz 6oz 16oz

+B Archive of 4-10
16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: B6W-RE-8416

Job No: 131014-01.01

Date: 7/8/13

Field Staff: CF, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1300

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1300			Y	4	

Sample Description:

0-1 cm - Shell hash
1-10 cm - GRAVELLY SAND, well graded (SW), wet, brown with slight black mottling. 90% sand, 10% gravel, trace shell. Some anthropogenic-like material (iron slag = pipe, decomposed) on surface. Moderate algae on surface.

Sample Containers: 1x16oz, 1x8oz, 1x4oz

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-17

Job No: 131014-01.01

Date:

Field Staff:

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1500

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: Subsurface sample collected from 4 of 5 locations, not collected from western location.

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1500			Y	4	
2	1510			Y	4-9	Archive

Sample Description: GRAVEL and COBBLES on surface (GW)
Surface - 8cm: SANDY GRAVEL, well-sorted (GW), damp, brown. 70% sand, 30% gravel.
8-16cm - Color changes to black. Moderate HC odor noted in 4 of 5 collection locations, not in west location.
Black layer ~2-4cm thick. Color changes back to brown to ~22cm.

Sample Containers:

2x16oz, 1x8oz, 1x4oz

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-18

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham / Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1453

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1453			Y	0.4	No odor

Sample Description:

Surface mostly gravel w/ Fucus on larger cobble

Brown med/coarse SAND. Moist. Soft
Gravel about 20% gravel
well graded

Sample Containers:

3 jars as noted below

Analyses:

TOC, PAH-SIM, Archive

402 602 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-19

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham/Hennings

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1500

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: Slight hydrocarbon odor

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1)	1500				0-4	center HC odor NW, SW, NE, SE all slight odor
B)	1513				4-8	HC odor - moderate Very hard w/ Gravel

Sample Description:

Surface large cobble with barnacles
Some open mud patches ~ 30% of surface of station

1) Olive brown surface dark gray med SAND w/ silt
30% gravel. Moist. Firm

B) Dark Gray/Black coarse SAND w/ 30% Gravel w/ cobble

Sample Containers:

Very Firm. Moist well Grade 2

4 Jars as noted below:

Analyses:

TOC, PAH-SIM, Archive

+ B- Archive

4oz 8oz 16oz

16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: 5620

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham/Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1254

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: Slight hydrocarbon odor

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1254			Y	0-4	Center HC odor All corners HC odor
B	1305			Y	4-8	Very slight H.C. odor

Sample Description:

#1 Edge of cape surface covered w/ cobble + barnacles
shell hash

olive on surface, dark gray SAND 15% gravel
Moist. Soft well graded

#B ~~med/coarse~~ olive gray SAND w/ 10% grav. Moist. Soft-
well graded - water filled holes

Sample Containers:

3 + 1 archive of B-interval

Analyses:

TOC, PAH-SIM, Archive

4 B-archive

8oz 8oz 16oz

16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-21

Job No: 131014-01.01

Date: July 8, 2015

Field Staff: Gillingham / Hennessey

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1445

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1445			X	0-4	No Odor

Sample Description:

Surface covered w/ pea gravel (25% cobble.

Brown med/coarse SAND moist. Soft
15% gravel well graded

Sample Containers:

3 jars as noted below:

Analyses:

TOC, PAH-SIM, Archive

9oz 8oz 16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-22

Job No: 131014-01.01

Date: 7/8/2013

Field Staff: DG - DH

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 11:15

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: Center NW, SE NE Slight Hydrocarbon odor
Archive all 4 aliquots

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	11:15			Y	0-10 4	
B	11:20			X	0-10	SG-22-13

Sample Description:

G1 COARSE SAND w/ Gravel ~15%
Dark gray in 1-2 inches of top interval w/
slight H.C. odor moist, soft well graded

B COARSE SAND w/ Gravel ~15%
slight H.C. odor moist, soft well graded
Dark gray lenses 5-6 then brown 6-10"

Sample Containers:

4 As noted Below

Analyses:

TOC, PAH-SIM, Archive

+ B archive
402 802 1602 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-23

Job No: 131014-01.01

Date:

Field Staff: Gillingham / Hennessey

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1220

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
<u>1</u>	<u>1220</u>			<u>Y</u>	<u>0-12</u>	<u>Slight H.C. odor in all aliquots</u>
<u>B</u>	<u>1225</u>			<u>Y</u>	<u>4-12</u>	<u>Very slight H.C. odor</u>

Sample Description:

#1 Cobble surface w/ barnacles
Dark gray SAND ^{very coarse} 5% gravel well sorted
few shells moist - non plastic

B Dark Gray ^{very coarse} SAND trace gravel Moist Soft
well sorted water filled hole

Sample Containers: 3 + 1 Archive of B interval

Analyses:

TOC, PAH-SIM, Archive

+

B-interval Archive

4oz 8oz 16oz

16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-24

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham/Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1435

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1435			Y	0-4	No odor

Sample Description: Surface covered in large gravel + pea gravel ~ 5-10% shell hash. Fucus on rocks. Olive brown med/coarse SAND. Moist. ^{DPH} Firm soft well graded. 15% gravel. 10% shell hash.

Sample Containers: 3 jars analyzed below

Analyses: TOC, PAH-SIM, Archive

402 802 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-25

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham/Henneghan

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1403

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes: Slight hydrocarbon odor

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1403			Y	0-4	center - slight HC odor NW, SW, NE, SE all slight HC odor
B	1404			Y	4-12	very slight HC odor

Sample Description: Surface mostly shell hash w/ some barnacle

covered cobble, surface SAND olive with

Dark gray at 0.5-2 inches associated w/ H.C. odor

then olive SAND. 10-15% gravel

Moist, soft

Dark Gray med./coarse SAND. 10% gravel

olive Moist, soft

Sample Containers:

4 jars as noted below

Analyses: TOC, PAH-SIM, Archive

+ B interval

4oz. 8oz 16oz

16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-26

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Collingham/Henneberry

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1204

Northing:

Height:

Tidal elevations estimated based on bathymetry 884

Notes: Hydrocarbon Odor - center - dark gray
No other points had odor

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1204			Y	0-4	Slight H.C. odor on center pt.
B	1214			Y	4-12	Center only had slight odor No sheen
						SG-26-B

Sample Description:

G1 Few cobbles on surface - mostly sand and shell hash
Dark gray SAND ~5% gravel
moist, soft -
B Dark gray SAND Moisture w/ water. Very soft
wet because hole filled in w/ water

Sample Containers: 4 As noted below:

Analyses:

TOC, PAH-SIM, Archive

1oz. 8oz. 16oz.

+ Archive B interval
16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-27

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: William / Dennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1354

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1354			Y	0-4	No Odor

Sample Description:

Barnacle covered cobble and shell hash on surf
Brown moist medium SAND
~ 5-10% shell hash ~ 10% gravel
moist. soft.

Sample Containers:

3 jars as noted below

Analyses:

TOC, PAH-SIM, Archive

702 802 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-28

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: O'Donoghue / Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1424

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1424			Y	0-4	No odor

Sample Description:

Surface barmacle covered cobble + gravel. Fucus seaweed.
Brown med/coarse SAND 10-15% gravel
Small green fust colored sand
well graded

Sample Containers:

3 as noted below:

Analyses:

TOC, PAH-SIM, Archive

1/62 802 1602



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-29

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham / Kennedy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1348

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
<u>1</u>	<u>1348</u>			<u>Y</u>	<u>0-4</u>	<u>No odor</u>

Sample Description:

Gravel + Cottle on surface
Brown next SAND w/ ~ 5% shell hash
Moist Soft. ~ 10% gravel - well graded

Sample Containers:

3 bags as noted below

Analyses:

TOC, PAH-SIM, Archive

4oz 8oz 16oz



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: SG-30

Job No: 131014-01.01

Date: July 8, 2013

Field Staff: Gillingham / Hennessy

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1115

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1115			Y	0-4	No odor

Sample Description:

cobble on surface w/ barnacles + clam shells
coarse SAND with ~10% gravel
olive brown surface w/ dark gray core ~1.5 in.
then brown gray to 4 in
Soft - Moist. & well graded

Sample Containers:

3 jars as noted below:

Analyses:

TOC, PAH-SIM, Archive

402 802 1602



DATE: 8/7/13

PROJECT NAME: Bremerton Gasworks

PROJECT NO: 131014-01.01

DAILY SAFETY BRIEFING

PERSON CONDUCTING
MEETING: D. Peterson

HEALTH & SAFETY
OFFICER: D. Templeton

PROJECT
MANAGER: M. Larsen

TOPICS COVERED:

- ☒ Emergency Procedures and Evacuation Route
- ☒ Directions to Hospital
- ☒ HASP Review and Location
- ☒ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/MSDS Location
- ☐ Fire Extinguisher Location
- ☒ Eye Wash Station Location
- ☐ Buddy System
- ☒ Self and Coworker Monitoring

- ☐ Lines of Authority
- ☒ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☒ Work Zones
- ☐ Vehicle Safety and Driving/Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☒ Decontamination Procedures
- ☐ Other:

- ☒ Lifting Techniques
- ☒ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☒ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☒ Eating/Drinking/Smoking

WEATHER CONDITIONS: Sunny, warm

DAILY WORK SCOPE: Beach grab
Sampling

SITE-SPECIFIC HAZARDS: Contaminated
Seds, hot weather

SAFETY COMMENTS: Drink water,
take breaks

ATTENDEES	
PRINTED NAME	SIGNATURE
Delaney Peterson	
Nik Bacher	
Paul Gussner	
Kathy Parker	
Nathan Socarras	



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-31

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1100

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1100			Y	4	

Sample Description:

Layer of gravel on surface.
Sand w/ gravel: Brown, moist, f-m sand (85%), 15% gravel
Shell hash in hole closest to shoreline.

Sample Containers: 1x4oz, 1x8oz, 1x16oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-32

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1200

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (In)	Comments
		Easting	Northing			
1	1200			Y	4	

Sample Description: Shell, gravel, and rip-rap, and algae (ulva) on surface. 2cm shell hash on surface.
Sand, gravel, and shell: Moist to wet, grey and white, 70% f-m sand, 25% shell, 5% gravel.

Sample Containers: 1x 40Z, 1x 80Z, 1x 160Z

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: PGW-RE-SG-33

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1115

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1115			Y	4	

Sample Description:

Algae on surface (fucus), gravel ^{is cobble} on surface
Sand and gravel with shell hash. Damp to wet, greyish-brown
70% f-m sand, 20% gravel, 10% shell hash

Sample Containers: 1x4oz, 1x8oz, 1x16 oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-SC-34

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1130

Northing:

Height:

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1130			Y	4	

Sample Description:

Gravel & cobble on surface
Sand, gravel, and shell. Damp, brown, f-n sand (85%). 15% gravel, 5% shell wash.

Sample Containers: 1 x 4oz, 1 x 8oz, 1 x 16oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-35

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1240

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1240			Y	4	

Sample Description: Shell hash on surface.
Damp, brown, f-n sand (85%), 15% gravel

Sample Containers: 1x 80z, 1x 40z, 1x 160z

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-S4-3C

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1200

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (In)	Comments
		Easting	Northing			
1	1200			Y	4	

Sample Description: Gravel on surface.

Sand with gravel, 70% f-m sand, 20% gravel, 10% shell hash with scattered orange brick fragments. Dry to moist, greyish brown. Trace clams. Trace pieces of black coal-like material. 1" piece of wire in homogenized material.

Sample Containers: 1x40z, 1x80z, 1x160z

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGM-RE-SL-37

Job No: 131014-01.01

Date: 8/7/13

Field Staff: AB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1230

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1230			Y	4	

Sample Description: Sand with gravel: Damp, brown, f-m sand (85%), 15% gravel. Trace brick fragments. Algae on surface (w/loc)

Sample Containers: 1x 4oz, 1x 8oz, 1x 16oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-38

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NIS, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1150

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes: _____

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
	1150			Y	4	

Sample Description:

Gravel and shell wash on surface.
Wet, brown and black, f-m sand (70%), 30% gravel.
~1/2" lens of black sand on surface in center hole and
two holes along shore. Trace worms.

Duplicate collected: BGW-RE-SG-88

Sample Containers: Sample: 1x40z, 1x80z, 1x160z; dup: 1x40z, 1x80z

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-39

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1255

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1255			Y	4	

Sample Description:

Sand with gravel and brick Wet, grayish brown. 90% f.w sand, 5% gravel, 5% brick fragments

Sample Containers: 1x4oz, 1x8oz, 1x16oz

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-SG-40

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1315

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1315			Y	4	

Sample Description:

Gravelly shell hash on surface
Moist, grey, 85% f-m sand, 15% gravel.

Sample Containers: 1x 1602

Analyses: -FOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-41

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1305

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
<u>1</u>	<u>1305</u>			<u>Y</u>	<u>4</u>	

Sample Description:

Gravel on surface.
Moist, dark grey, 75% f-in sand, 25% gravel

Sample Containers:

1 x 160Z

Analyses:

TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BLW-RE-SG-42

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1125

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1125					

Sample Description: Gravel & cobble on surface.

Sand and gravel: Damp, brown, ~~sand~~ grey, and black ~ 2" layer of black, on surface. 85% sand, 15% gravel. Trace shell hash (25%).

Sample Containers: 1 x 16 oz

Analyses: TOC, PAH-SIM, Archive



Surface Sediment Field Log

Job: Bremerton Gasworks

Station: BGW-RE-SG-43

Job No: 131014-01.01

Date: 8/7/13

Field Staff: NB, DP

Sample Method: Hand Collection

Proposed Coordinates:

Tide Measurements

Horizontal Datum: NAD 83 Wa. SP North, U.S. ft

Easting:

Time: 1320

Northing:

Height: _____

Tidal elevations estimated based on bathymetry

Notes:

Grab #	Time	Confirmed Coordinates		Sample Accept (Y/N)	Recovery Depth (in)	Comments
		Easting	Northing			
1	1320			Y	4	

Sample Description:

Gravel on Surface.
Damp, brown and black, 85% f-m sand, 15% gravel.
Black lens, ~2" thick from surface in northern and
east western holes.

Sample Containers: 1 x 16 oz

Analyses:

TOC, PAH-SIM, Archive

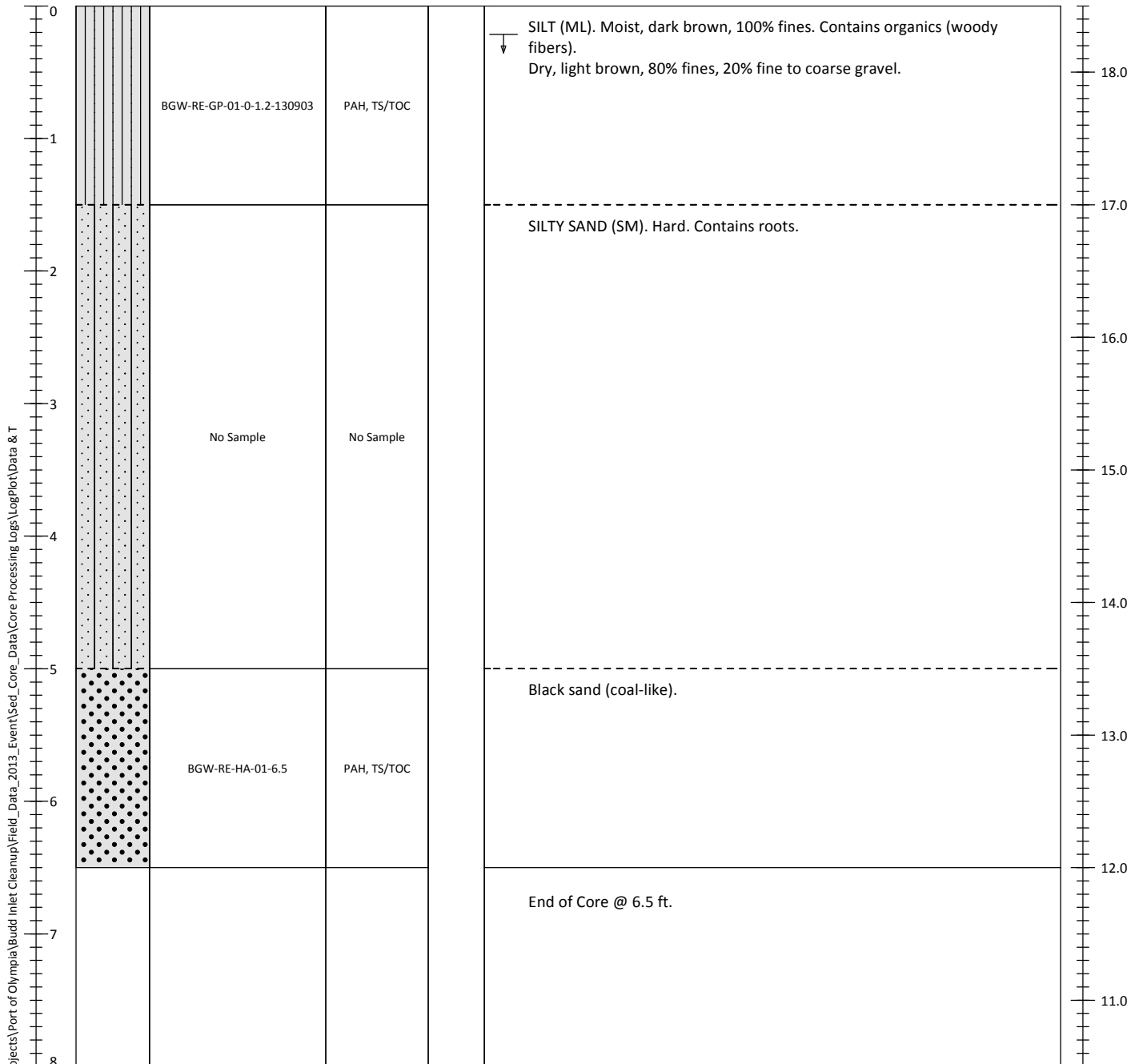
Sediment Core Log

BGW-RE-GP-01 / BGW-RE-HA-01

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 1.5
Collection Date: 9/3/2013-9/4/2013	Ground Elevation (ft): 18.5	Field Recovery Length (ft): 1.2
Contractor: Cascade Drilling	N/LAT 216292.172856 E/LONG: 1193728.93267	Process Date: 9/3/2013-9/4/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM/NB

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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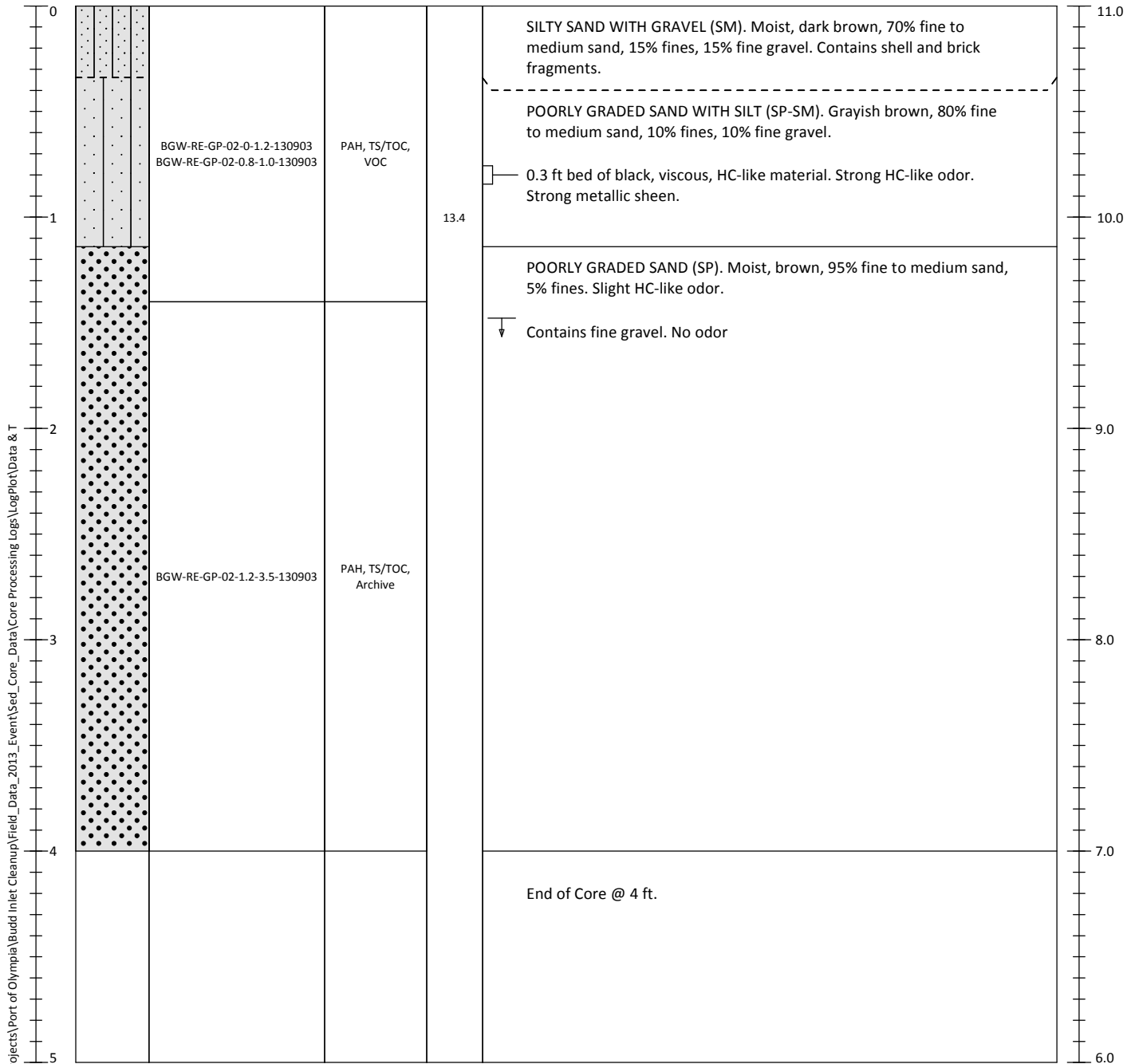
Sediment Core Log

BGW-RE-GP-02

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 4
Collection Date: 9/3/2013	Ground Elevation (ft): 11	Field Recovery Length (ft): 3.5
Contractor: Cascade Drilling	N/LAT 216292.78834 E/LONG: 1193748.64851	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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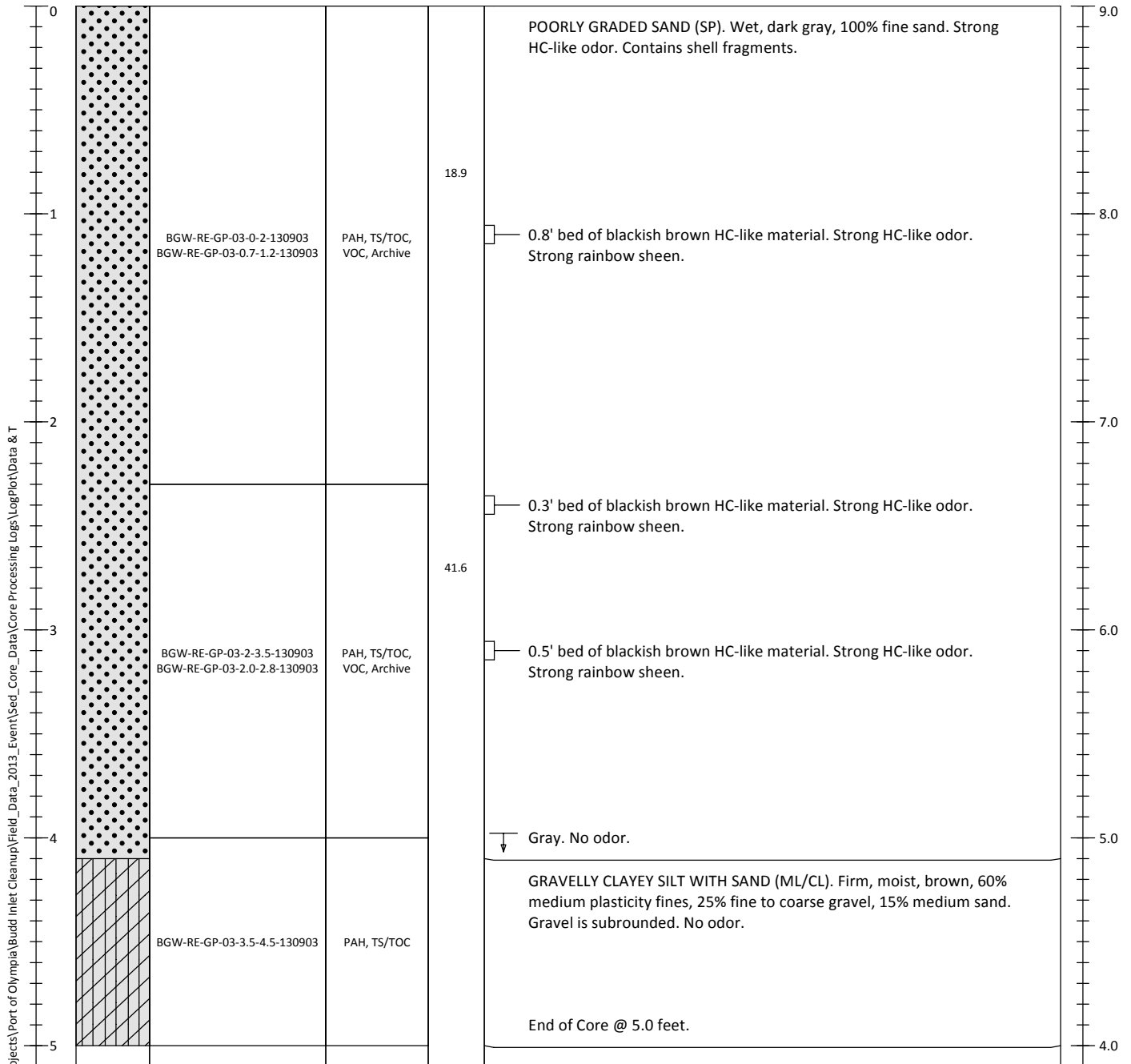
Sediment Core Log

BGW-RE-GP-03

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 5.0
Collection Date: 9/3/2013	Ground Elevation (ft): 9.0	Field Recovery Length (ft): 4.5
Contractor: Cascade Drilling	N/LAT 216308.832272 E/LONG: 1193728.80997	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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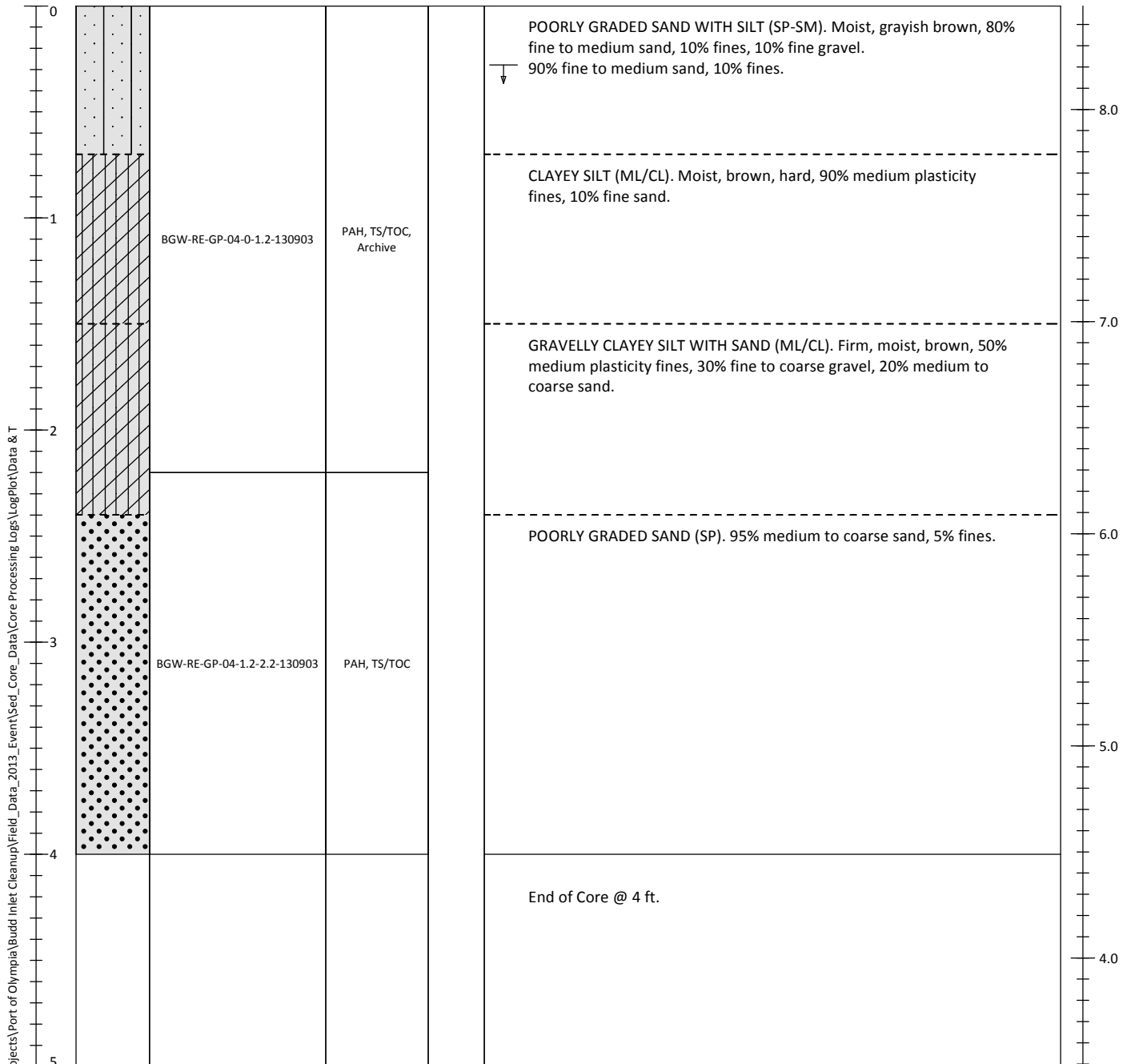
Sediment Core Log

BGW-RE-GP-04

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 4
Collection Date: 9/3/2013	Ground Elevation (ft): 8.48804664612	Field Recovery Length (ft): 2.2
Contractor: Cascade Drilling	N/LAT 216308.042247 E/LONG: 1193753.30598	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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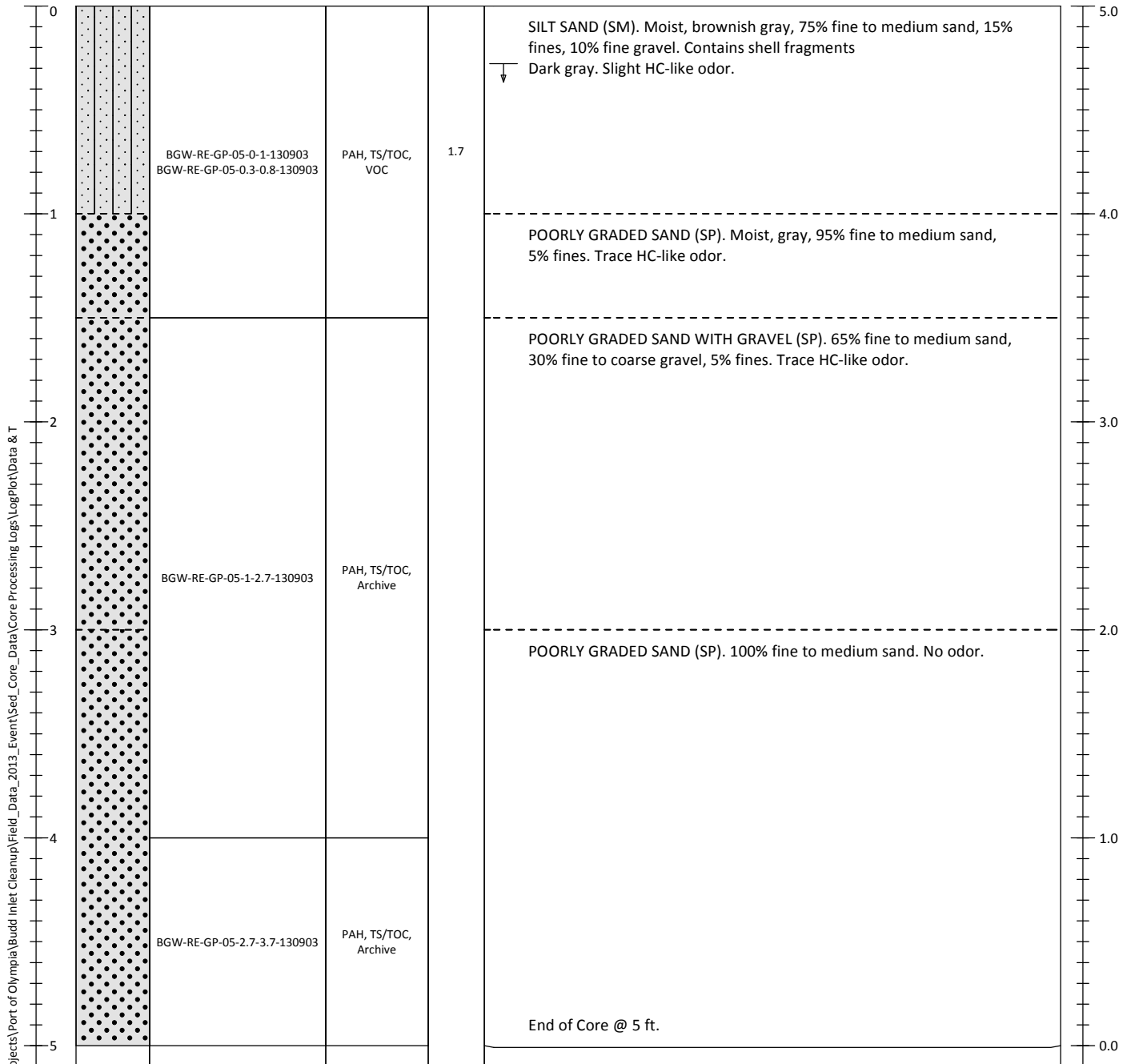
Sediment Core Log

BGW-RE-GP-05

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 5.0
Collection Date: 9/3/2013	Ground Elevation (ft): 5.0	Field Recovery Length (ft): 3.7
Contractor: Cascade Drilling	N/LAT 216336.173096 E/LONG: 1193729.28405	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM/NB

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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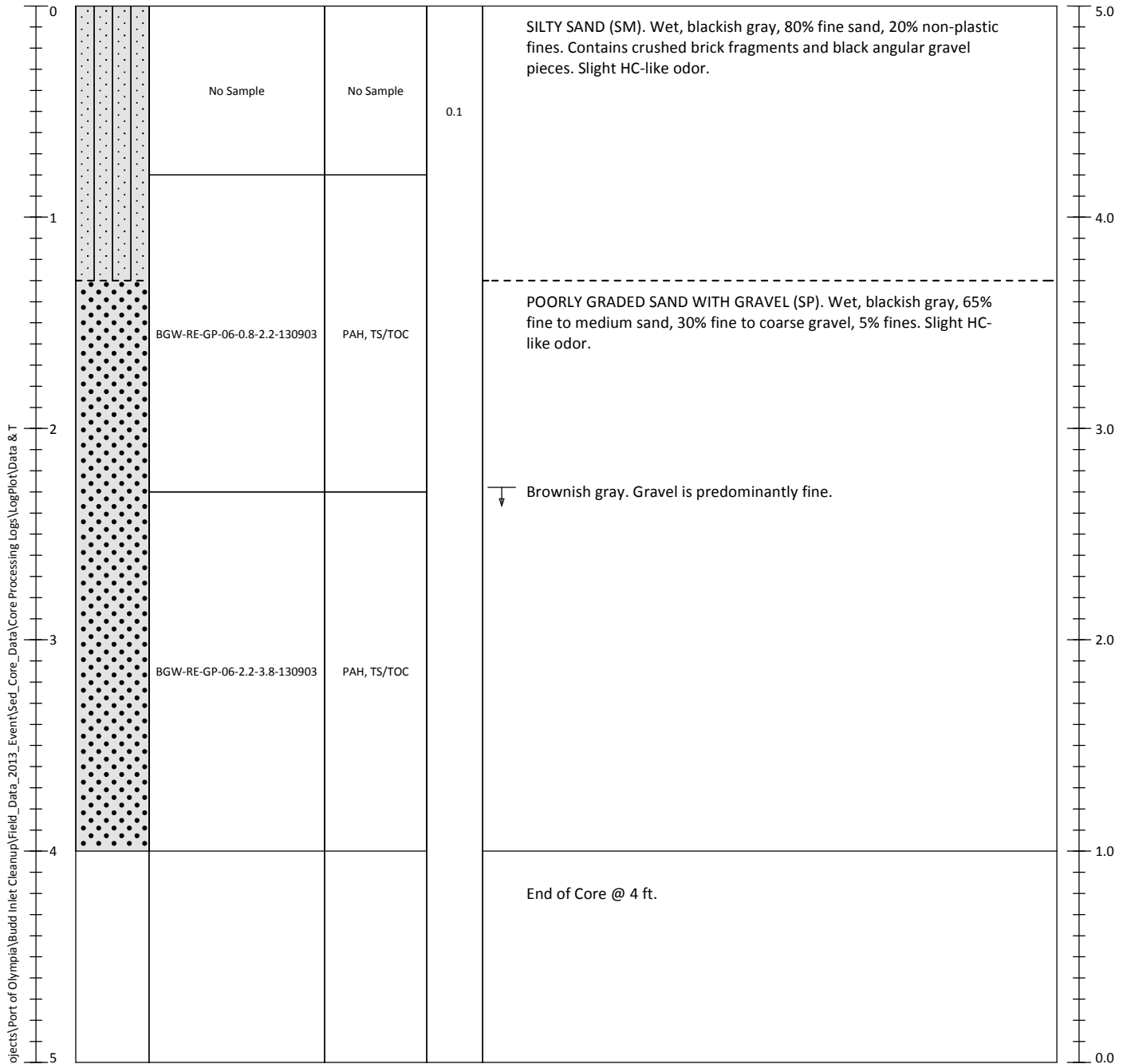
Sediment Core Log

BGW-RE-GP-06

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 4
Collection Date: 9/3/2013	Ground Elevation (ft): 5.0	Field Recovery Length (ft): 3.8
Contractor: Cascade Drilling	N/LAT 216335.224935 E/LONG: 1193752.04155	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM/NB

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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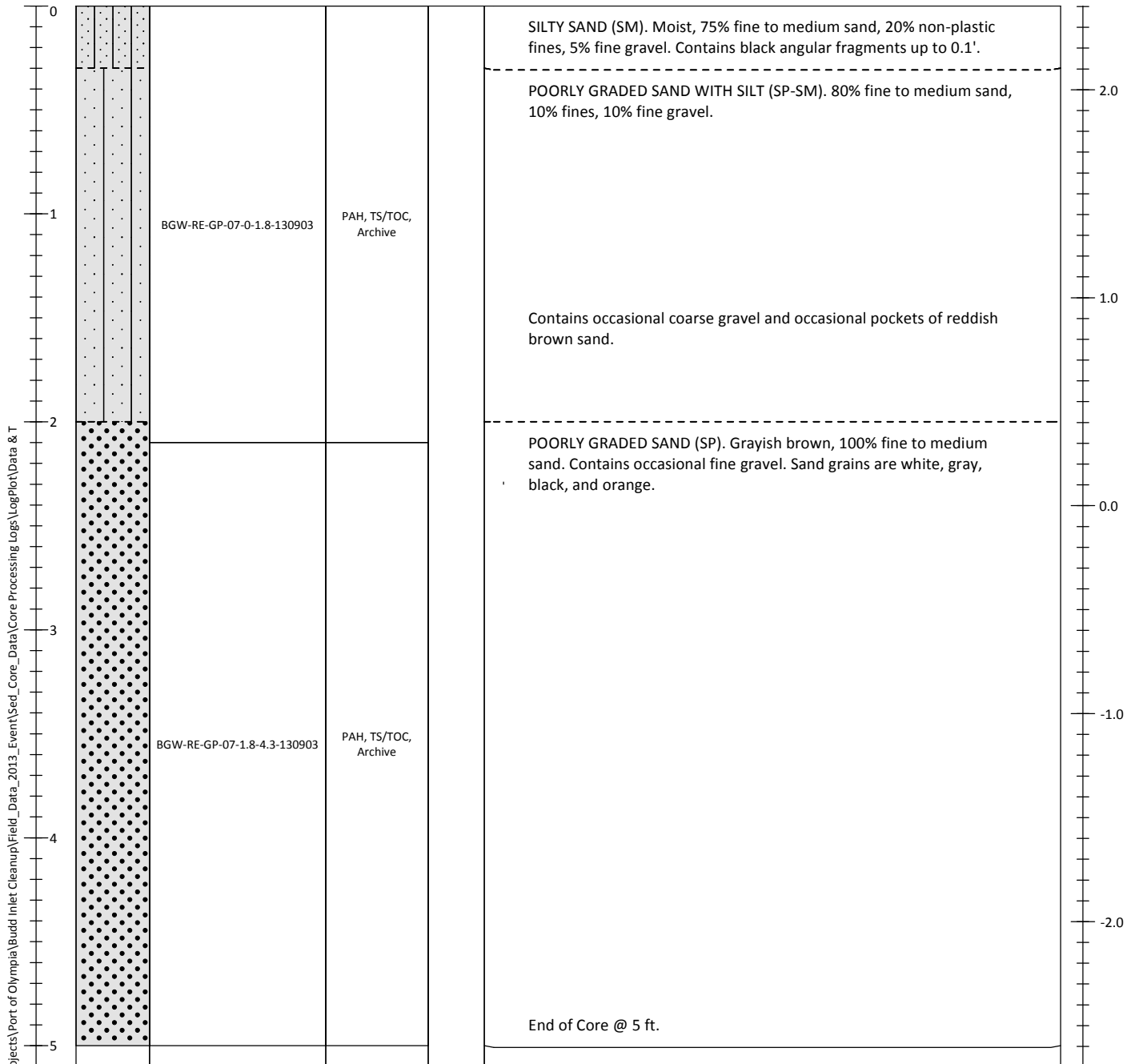
Sediment Core Log

BGW-RE-GP-07

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 5
Collection Date: 9/3/2013	Ground Elevation (ft): 2.4	Field Recovery Length (ft): 4.3
Contractor: Cascade Drilling	N/LAT 216361.617599 E/LONG: 1193727.8618	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM/NB

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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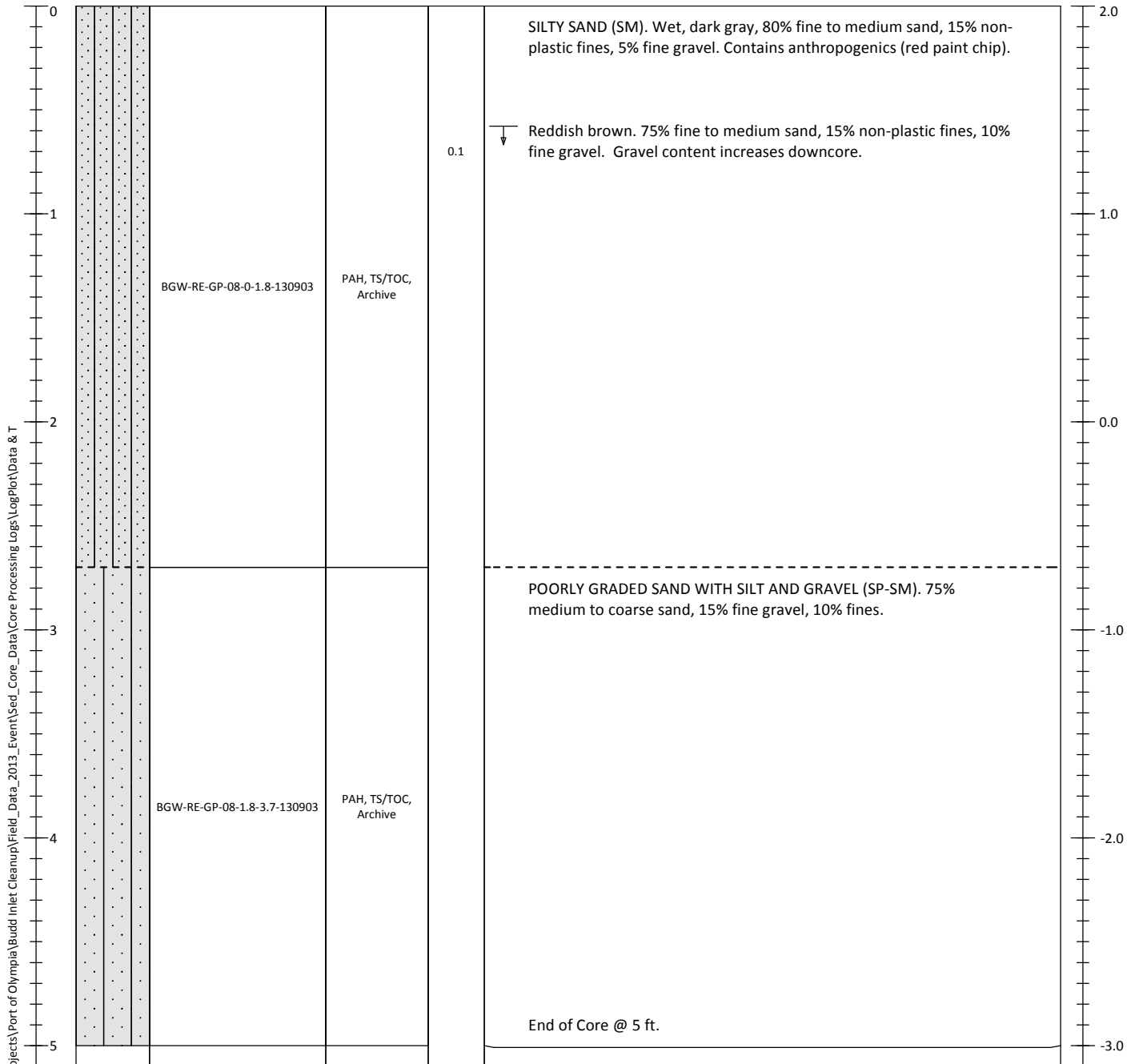
Sediment Core Log

BGW-RE-GP-08

Sheet 1 of 1

Project: Bremerton Gas Works Site	Location: Bremerton, WA	Tube Length (ft): 4 ft. sections
Project #: 131014-01.01	Client: Cascade Natural Gas Corporation	Penetration Depth (ft): 5
Collection Date: 9/3/2013	Ground Elevation (ft): 2.3	Field Recovery Length (ft): 3.7
Contractor: Cascade Drilling	N/LAT 216361.143519 E/LONG: 1193752.04155	Process Date: 9/3/2013
Drill Rig Type: 54 LT Limited Access Geoprobe	Horiz. Datum: NAD 83 N Vert. Datum: MLLW	Process Method: Cut tube
Operator: Frank Scott	Method/Tube ID: Geoprobe/1.5"	Sample Quality: Good Logged By: EM/NB

In-Situ Depth (ft)	In-Situ Interval	Sample	Chemical Analysis	PID	Sediment Description Samples and Descriptions are in In-Situ Depths. Classification Scheme: USCS	Estimated In-situ Elevation (MLLW)
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APPENDIX F

Soil, Groundwater, and Sediment Data

Table F-1 - Groundwater Quality Data

Bremerton Gas Works Site
Bremerton, Washington

Chemical Name	Preliminary Groundwater PRG	Preliminary SW PRG (for GW Screening)	MP03 5/19/08	MP04 5/15/08	MW-1 6/1/07	MW-2 6/1/07	MW-3 6/1/07	MW-4 6/1/07	MW-5 6/1/07	MW-6 6/1/07	MW-6 6/1/07 FD	MW-7 6/1/07	MW-8 6/1/07	SP02 5/15/08
Total Petroleum Hydrocarbons (TPH)														
Gasoline Range Hydrocarbons in ug/L			50 U	1,300 U	50.0 U	63.5	2,800	10,600	481	3,450	3,400	174	4,850	50 U
Diesel Range Hydrocarbons in ug/L			170 JL	510 J	236 U	236 U	236 U	18,500 Q5	236 U	540 QP	646 QP	447	1,860 Q5	250 U
Oil Range Hydrocarbons in ug/L			160 JL	500 U	472 U	472 U	472 U	2,360 U	472 U	472 U	472 U	472 U	472 U	500 U
Metals														
Total Antimony in ug/L	0.78	90		0.4 JQ	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	0.3 JQ
Total Arsenic in ug/L	0.052	0.14		4.1 J	1.54	1.08	14.2	26	2.83	4.8	4.43	1.43	4.69	0.6 J
Total Barium in ug/L	380			173										35.7
Total Beryllium in ug/L	2.5	0.66		0.37 JQ	1 U	1 U	1.07	1.08	1 U	1 U	1 U	1 U	1 U	1 U
Total Cadmium in ug/L	0.92	8.8		0.16 JQ	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 JQ
Total Chromium (Total) in ug/L	100	42		69.6	11.8	5.15	228	177	6.07	1.34	1.06	15.6	9.28	2.4
Total Chromium (VI) in ug/L	0.035	50			6	5 U	48	33	61	23	33	11	90	
Total Cobalt in ug/L	0.6			8.3 J										1.4 J
Total Copper in ug/L	80	3.1		32 J	10.1	3.4	130	143	9	1.05	1 U	13.1	8.94	1.9 JQ
Total Lead in ug/L	15	8.1		8 J	1.55	1 U	18.3	21.6	5.12	1 U	1 U	2.23	4.47	0.44 JQ
Total Manganese in ug/L	43			3,020										98.1
Total Mercury in ug/L	0.063	0.94			0.2 U	0.2 U	0.246	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	
Total Nickel in ug/L	39	8.2		38.2 J	18.7	7.24	232	180	89.7	1.65	1.32	20.2	14.4	5.2 J
Total Selenium in ug/L	10	71		5 UJ	1 U	1 U	1 U	1 U	3.64	1 U	1 U	1 U	1 U	5 UJ
Total Silver in ug/L	9.4	1.9		0.07 JQ	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
Total Thallium in ug/L	0.02	6.3		0.26 JQ	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total Vanadium in ug/L	8.6			78.2										3.7 JQ
Total Zinc in ug/L	600	81		37.2 J	13.4	10 U	185	155	32.1	10 U	10 U	18	12.7	4.5 J
TCLP Metals														
Total Mercury in ug/L					0.2 U	0.2 U	0.246	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	
Organometallics														
Tributyltin in ug/L	2.8	0.0074			0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	
Polycyclic Aromatic Hydrocarbons (PAHs)														
Acenaphthene in ug/L	53	30			0.102 U	0.0971 U	1.10	485	14.5	20.1	16.3	0.0943 U	12.3	0.05 U
Acenaphthylene in ug/L		4,840		5.4 J	0.102 U	0.0971 U	9.71 U	25.1	3.10	34.9	27.8	0.222	9.41	0.05 U
Anthracene in ug/L	180	100		0.4	0.102 U	0.0971 U	9.71 U	120	0.726	4.23	1.32	0.0943 U	0.891	0.05 U
Benzo(g,h,i)perylene in ug/L		7.64		0.05 U	0.102 U	0.0971 U	0.0979	25.6	0.639	0.221	0.104	0.0943 U	0.500	0.05 U
Dibenzofuran in ug/L	0.79	4		0.29 J	10.2 U	9.71 U	9.71 U	31.8	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Fluoranthene in ug/L	80	6		0.26	0.102 U	0.0971 U	1.95	122	3.29	11.2	9.68	0.0943 U	1.72	0.05 U
Fluorene in ug/L	29	10		0.25	0.102 U	0.0971 U	3.31	184	1.36	15.3	5.34	0.102	0.873	0.05 U
Phenanthrene in ug/L		1.5		0.05 U	0.102 U	0.0971 U	5.78	377	1.46	5.73	0.0943 U	0.0943 U	1.04	0.05 U
Pyrene in ug/L	12	8		0.36	0.102 U	0.0971 U	2.36	34.5	3.90	13.6	11.1	0.174	2.92	0.05 U
1-Methylnaphthalene in ug/L	1.1	2.1			0.102 U	0.0971 U	16.8	970	9.43 U	59.4	9.47	0.0943 U	0.813	
2-Methylnaphthalene in ug/L	3.6	4.2		0.35	0.102 U	0.0971 U	0.415	1,430	1.20	0.0943 U	0.0943 U	0.0943 U	0.367	0.13
Naphthalene in ug/L	0.17	1.4		10 J	0.102 U	0.0971 U	345	5,270	25.5	54.9	64.6	3.19	1,070	0.47
Benz(a)anthracene in ug/L	0.012	0.00016		0.05 U	0.0102 U	0.00971 U	0.389	39.3	0.884	0.727	0.430	0.0168	0.694	0.05 U
Benzo(a)pyrene in ug/L	0.0034	0.000016		0.05 U	0.0102 U	0.00971 U	0.217	37.6	0.905	0.345	0.158	0.0247	0.878	0.05 U
Benzo(b)fluoranthene in ug/L	0.034	0.00016		0.05 U	0.0102 U	0.00971 U	0.0968	9.43 U	0.637	0.272	0.115	0.00943 U	0.657	0.05 U
Benzo(k)fluoranthene in ug/L	0.34	0.0016		0.05 U	0.0102 U	0.00971 U	0.227	9.43 U	0.615	0.281	0.189	0.0602	0.494	0.05 U
Chrysene in ug/L	3.4	0.016		0.05 U	0.0102 U	0.00971 U	0.432	40.8	1.16	0.772	0.392	0.0372	0.836	0.05 U
Dibenzo(a,h)anthracene in ug/L	0.0034	0.000016		0.05 U	0.0102 U	0.00971 U	0.0437	9.43 U	0.189	0.0678	0.0723	0.00943 U	0.170	0.05 U
Indeno(1,2,3-cd)pyrene in ug/L	0.034	0.00016		0.05 U	0.0102 U	0.00971 U	0.0874	9.43 U	0.467	0.167	0.0985	0.00943 U	0.433	0.05 U
Total cPAHs TEQ (ND = 0) in ug/L	0.0034	0.000016		ND	ND	ND	0.306	41.9	1.2	0.504	0.252	0.0328	1.13	ND
Total cPAHs TEQ (ND = 1/2 RDL) in ug/L	0.0034	0.000016		ND	ND	ND	0.306	43.8	1.2	0.504	0.252	0.0342	1.13	ND

Table F-1 - Groundwater Quality Data

Bremerton Gas Works Site
Bremerton, Washington

Chemical Name	Preliminary Groundwater PRG	Preliminary SW PRG (for GW Screening)	MP03 5/19/08	MP04 5/15/08	MW-1 6/1/07	MW-2 6/1/07	MW-3 6/1/07	MW-4 6/1/07	MW-5 6/1/07	MW-6 6/1/07	MW-6 6/1/07 FD	MW-7 6/1/07	MW-8 6/1/07	SP02 5/15/08
Other (Non-PAH) Semivolatiles														
1,1'-Biphenyl in ug/L	0.083	14		0.5 U										0.5 U
1,2,4,5-Tetrachlorobenzene in ug/L	0.17	1.1		0.5 U										0.5 U
1,2,4-Trimethylbenzene in ug/L	1.5	19		0.5 U										
2,3,4,6-Tetrachlorophenol in ug/L	24	1.2		0.5 U										0.5 U
2,4,5-Trichlorophenol in ug/L	120	12		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2,4,6-Trichlorophenol in ug/L	1.2	0.28		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2,4-Dichlorophenol in ug/L	4.6	10		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2,4-Dimethylphenol in ug/L	36	97		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2,4-Dinitrophenol in ug/L	3.9	100		2.5 U	20.4 U	19.4 U	19.4 U	18.9 U	18.9 U	18.9 U	18.9 U	18.9 U	19.8 U	2.5 U
2-Chloronaphthalene in ug/L	75	100		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2-Chlorophenol in ug/L	9.1	17		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
2-Methylphenol in ug/L	93	67			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
2-Nitroaniline in ug/L	19			1 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	1 U
2-Nitrophenol in ug/L		2,940		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
3 & 4 Methylphenol in ug/L					10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
3,3'-Dichlorobenzidine in ug/L	0.13	0.0033		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
3-Nitroaniline in ug/L				1 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	1 U
4,6-Dinitro-2-methylphenol in ug/L	0.15	7		1 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	1 U
4-Bromophenyl phenyl ether in ug/L		1.5		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
4-Chloro-3-methylphenol in ug/L	140	36		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
4-Chloroaniline in ug/L	0.37	232		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
4-Chlorophenyl phenyl ether in ug/L				0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 UJ
4-Methylphenol in ug/L	190	25		0.5 U										0.5 U
4-Nitroaniline in ug/L	3.8			1 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	1 U
4-Nitrophenol in ug/L		60		1 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	1 U
Acenaphthene in ug/L	53	30		4.9 J										
Acetophenone in ug/L	190			0.5 U										0.5 U
Aniline in ug/L	13	2.2			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
Atrazine in ug/L	0.3	1.8		0.5 U										0.5 U
Benzaldehyde in ug/L	19			0.5 U										0.5 U
Benzidine in ug/L	0.00011	0.000023		0.5 U										0.5 U
Benzoic acid in ug/L	7,500	42			20.4 U	19.4 U	19.4 U	18.9 U	18.9 U	18.9 U	18.9 U	18.9 U	19.8 U	
Benzyl alcohol in ug/L	200	8.6			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
Benzyl butyl phthalate in ug/L	16	0.013		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.33 J
Bis(2-chloro-1-methylethyl) ether in ug/L	71	900		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Bis(2-chloroethoxy)methane in ug/L	5.9			0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Bis(2-chloroethyl) ether in ug/L	0.014	0.06		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Bis(2-ethylhexyl) phthalate in ug/L	5.6	0.046		0.5 J	51.0 U	48.5 U	48.5 U	47.2 U	47.2 U	47.2 U	47.2 U	47.2 U	49.5 U	0.33 J
Caprolactam in ug/L	990			0.71 J										0.5 U
Carbazole in ug/L				1.3 J	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Diethyl phthalate in ug/L	1,500	200		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Dimethyl phthalate in ug/L		600		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Di-n-butyl phthalate in ug/L	90	8		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Di-n-octyl phthalate in ug/L	20	22		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Hexachlorobenzene in ug/L	0.0098	0.000005		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Hexachlorocyclopentadiene in ug/L	0.041	1		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Hexachloroethane in ug/L	0.33	0.02		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Isophorone in ug/L	78	110		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Nitrobenzene in ug/L	0.14	100			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
N-Nitrosodimethylamine in ug/L	0.00011	0.34		0.5 U										0.5 U
N-Nitroso-di-n-propylamine in ug/L	0.011	0.058		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
N-Nitrosodiphenylamine in ug/L	12	0.69		0.5 U	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	0.5 U
Pentachlorophenol in ug/L	0.041	0.002		0.1	10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	11.4	0.1 U
Phenol in ug/L	580	70,000		0.5 U	10.2 U	9.71 U	75.5	9.43 U	9.43 U	77.5	62.6	9.43 U	81.6	0.05 U
2,4-Dinitrotoluene in ug/L	0.24	0.18			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	
2,6-Dinitrotoluene in ug/L	0.049	81			10.2 U	9.71 U	9.71 U	9.43 U	9.43 U	9.43 U	9.43 U	9.43 U	9.90 U	

Aspect Consulting

3/9/2017

V:\080239 Bremerton Former MGP Site\Deliverables\RI FS Workplan\Final\Appendices\F Soil, Groundwater, Sediment Data\Single Files\New\Table F-1 Groundwater Quality Data

Table F-1

RI/FS Work Plan

Table F-1 - Groundwater Quality Data

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Bremerton, Washington

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Volatile Organic Compounds (VOC)														
1,1,1,2-Tetrachloroethane in ug/L	0.57			0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,1,1-Trichloroethane in ug/L	200	50,000		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,1,2 - Trichlorotrifluoroethane in ug/L	5,500			0.25 U										0.25 U
1,1,2,2-Tetrachloroethane in ug/L	0.076	0.3		0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
1,1,2-Trichloroethane in ug/L	0.041	0.9		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,1-Dichloroethane in ug/L	2.8	47		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,1-Dichloroethene in ug/L	7	4,000			0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,1-Dichloropropene in ug/L					0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	
1,2,3-Trichlorobenzene in ug/L	0.7	8		0.5 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.5 U
1,2,3-Trichloropropane in ug/L	0.00075			0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
1,2,4-Trichlorobenzene in ug/L	0.4	0.037		0.5 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.5 U
1,2,4-Trimethylbenzene in ug/L	1.5	19			0.200 U	0.200 U	9.36	179	3.52	10.3	10.6	0.200 U	40.4	0.5 U
1,2-Dibromo-3-chloropropane in ug/L	0.00033			0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
1,2-Dibromoethane (EDB) in ug/L	0.0075			0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,2-Dichlorobenzene in ug/L	30	800		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,2-Dichloroethane (EDC) in ug/L	0.17	73		0.25 U	0.200 U	4.72	3.06	0.200 U	0.200 U	0.930	0.850	0.200 U	0.200 U	0.25 U
1,2-Dichloropropane in ug/L	0.44	3.1		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,3,5-Trimethylbenzene in ug/L	12	71		0.5 U	0.500 U	0.500 U	1.87	30.0	0.530	1.26	1.22	0.500 U	5.60	0.5 U
1,3-Dichlorobenzene in ug/L		2		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
1,3-Dichloropropane in ug/L	37				0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	
1,4-Dichlorobenzene in ug/L	0.48	200		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
2,2-Dichloropropane in ug/L					0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	
2-Butanone in ug/L	560	2,200		5 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	5 U
2-Chlorotoluene in ug/L	24				0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	
2-Hexanone in ug/L	3.8	99		5 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	5 U
4-Chlorotoluene in ug/L	25				0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	
4-Methyl-2-pentanone in ug/L	630	170		5 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	5 U
Acetone in ug/L	1,400	1,700		5 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	5 U
Benzene in ug/L	0.46	1.6		70	0.200 U	18.4	826	25.2	85.1	950	826	2.23	650	0.35 U
Bromobenzene in ug/L	6.2				0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	
Bromochloromethane in ug/L	8.3			0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Bromodichloromethane in ug/L	0.13	2.8		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Bromoform in ug/L	3.3	12		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Bromomethane in ug/L	0.75	2,400		0.25 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	0.25 U
Carbon disulfide in ug/L	81	0.92		0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
Carbon tetrachloride in ug/L	0.46	0.35		0.25 U	0.660	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Chlorobenzene in ug/L	7.8	200		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Chloroethane in ug/L	2,100			0.25 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.25 U
Chloroform in ug/L	0.22	600		0.25 U	2.84	1.42	0.200	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Chloromethane in ug/L	19	2,700		0.25 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.25 U
cis-1,2-Dichloroethene (DCE) in ug/L	3.6			0.25 U	0.200 U	0.200 U	0.370	1.29	0.200 U	0.740	0.770	0.200 U	0.200 U	0.25 U
cis-1,3-Dichloropropene in ug/L		1.2		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Cyclohexane in ug/L	1,300			0.38										0.25 U
Dibromochloromethane in ug/L	0.87	2.2		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Dibromomethane in ug/L	0.83				0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	
Dichlorodifluoromethane in ug/L	20			0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
Ethylbenzene in ug/L	1.5	31		26	0.200 U	0.200 U	151	322	10.1	187	160	0.530	244	0.25 U
Hexachlorobutadiene in ug/L	0.14	0.01		0.25 U	2.50 U	2.50 U	2.50 U	2.50 U	2.50 U	2.50 U	2.50 U	2.50 U	2.50 U	0.25 U
Isopropylbenzene in ug/L	45	2.6		3	0.500 U	0.500 U	5.29	37.4	5.25	8.93	8.90	0.500 U	8.15	0.25 U
Methyl acetate in ug/L	2,000			0.25 U										0.25 U
Methyl tert-butyl ether (MTBE) in ug/L	14	11,070		0.25 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.25 U
Methylcyclohexane in ug/L				0.25 U										0.25 U
Methylene chloride in ug/L	5	100		0.25 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	0.25 U
n-Butylbenzene in ug/L	100				0.200 U	0.200 U	0.480	5.30	0.200 U	0.590	0.520	0.200 U	0.580	
n-Hexane in ug/L	150	0.58			1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.17	1.00 U	1.00 U	1.00 U	

Table F-1 - Groundwater Quality Data

Bremerton Gas Works Site
Bremerton, Washington

Chemical Name	Preliminary Groundwater PRG	Preliminary SW PRG (for GW Screening)	MP03 5/19/08	MP04 5/15/08	MW-1 6/1/07	MW-2 6/1/07	MW-3 6/1/07	MW-4 6/1/07	MW-5 6/1/07	MW-6 6/1/07	MW-6 6/1/07 FD	MW-7 6/1/07	MW-8 6/1/07	SP02 5/15/08
n-Propylbenzene in ug/L	66	128			0.500 U	0.500 U	6.41	9.20	0.500 U	3.14	3.29	0.500 U	2.38	
p-Isopropyltoluene in ug/L		85			0.200 U	0.200 U	0.900	8.44	0.200 U	0.270	0.250	0.200 U	1.17	
sec-Butylbenzene in ug/L	200				0.200 U	0.200 U	0.370	4.43	0.200 U	0.360	0.400	0.320	0.570	
Styrene in ug/L	100	32		0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
tert-Butylbenzene in ug/L	69				0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	
Tetrachloroethene (PCE) in ug/L	4.1	2.9		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Toluene in ug/L	110	130		1.5	0.200 U	0.200 U	4.21	41.9	0.450	3.07	3.17	0.200 U	1.49	0.25 U
trans-1,2-Dichloroethene in ug/L	36	1,000		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
trans-1,3-Dichloropropene in ug/L		1.2		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
Trichloroethene (TCE) in ug/L	0.28	0.7		0.25 U	4.79	0.610	0.330	0.630	0.200 U	0.200 U	0.200 U	0.400	0.200 U	0.49 J
Trichlorofluoromethane in ug/L	520			0.25 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.25 U
Vinyl chloride in ug/L	0.019	0.18		0.25 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.25 U
m,p-Xylenes in ug/L				0.74 J	0.500 U	0.500 U	22.4	383	3.38	6.54	7.55	0.500 U	88.4	0.25 U
o-Xylene in ug/L	19			5.8	0.250 U	0.250 U	17.2	211	4.91	12.6	12.7	0.250 U	111	0.25 U
Xylenes (total) in ug/L	19	19			0.750 U	0.750 U	39.6	593	8.29	19.2	20.3	0.750 U	191	
Polychlorinated Biphenyls (PCBs)														
Aroclor 1016 in ug/L	0.14				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1221 in ug/L	0.0047				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1232 in ug/L	0.0047				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1242 in ug/L	0.0078				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1248 in ug/L	0.0078				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1254 in ug/L	0.0078				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1260 in ug/L	0.0078				0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1262 in ug/L					0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	
Aroclor 1268 in ug/L					0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	

Notes
Concentrations in shaded cells indicate value exceeds groundwater PRG.
Concentrations within bold border indicate value exceeds SW PRG (for GW Screening).
Where a sample has multiple results for a given analyte (tested for in multiple methods) the highest detected value is shown. Where all results were non-detects, the result with the lowest detection limit is shown.
J = Analyte was positively identified. The reported result is an estimate.
JL = Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample. Lowest available reporting limit for the analytical method used.
JQ = Approximate value due to quality control problems.
PRG = preliminary remediation goal
Q5 = Results in the diesel organics range are primarily due to overlap from a gasoline range product.
QP = Hydrocarbon result partly due to individual peak(s) in quantitation range.
SW PRG = surface preliminary remediation goal
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	BGW-RE-GP-01 9/3/13 (0-1.5ft)	BGW-RE-HA-01 9/4/13 (5-6.5ft)	MP01 5/14/08 (3.5-5ft)	MP01 5/14/08 (8.5-10ft)	MP01 5/14/08 (13.5-15ft)	MP01 5/14/08 (18.5-20ft)	MP01 5/14/08 (23.5-25ft)	MP01 5/14/08 (28.5-30ft)	MP01 5/14/08 (33.5-35ft)	MP02 5/19/08 (3.5-5ft)	MP02 5/19/08 (8.5-10ft)	MP02 5/19/08 (13.5-15ft)	MP02 5/19/08 (18.5-20ft)	MP02 5/19/08 (23.5-25ft)	MP02 5/19/08 (28.5-30ft)	MP03 5/19/08 (3.5-5ft)	MP03 5/19/08 (8.5-10ft)	MP03 5/19/08 (18.5-20ft)
Total Petroleum Hydrocarbons (TPH)																			
Gasoline Range Hydrocarbons (mg/kg)				500 U	170 U	7 U	7 U	6 U	6 U	6 U	6 U	7 U	6 U	6 U	5 U	6 U	8 U	5 U	6 U
Diesel Range Hydrocarbons (mg/kg)				500 U	250 U	160 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Oil Range Hydrocarbons (mg/kg)				250	500 U	50 U	50 U	50 U	50 U	50 U	18	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Metals																			
Aluminum (mg/kg)	7,700			11,200 J	11,200 J	7,360 J	6,760 J	9,680 J	11,300 J	18,500	14,600	11,500	8,700	8,120	7,850	7,240	19,300	7,670	12,200
Antimony (mg/kg)	0.27									7.5 UJ	0.8 JQ								
Arsenic (mg/kg)	0.68			1.1	2	0.9	0.8	1	1.6	3.2	1.2	0.8	0.5	0.5	0.8	0.7	4	0.9	1
Barium (mg/kg)	330			46.1 J	45.7 J	31.8 J	30.1 J	37.9 J	37.8 J	89.1	64.5	43.1	35.4	36.9	35.1	33.5	113	43.6	51.5
Beryllium (mg/kg)	16			0.2 JQ	0.2 JQ	0.2 JQ	0.2 JQ	0.2 JQ	0.2 JQ	0.4 J	0.4 JQ	0.3 JQ	0.3 JQ	0.2 JQ	0.2 JQ	0.2 JQ	0.5 JQ	0.3 JQ	0.4 JQ
Cadmium (mg/kg)	0.36			0.3 JQ	0.3 JQ	0.2 JQ	0.2 JQ	0.3 JQ	0.5 JQ	0.9	0.6 U	0.6 U	0.5 U	0.6 U	0.5 U	0.5 U	0.6 U	0.5 U	0.6 U
Calcium (mg/kg)				3,200	3,300	3,040	3,030	3,210	5,310	7,150	1,620	1,840	2,250	2,070	2,130	2,040	5,200	2,960	2,770
Chromium (Total) (mg/kg)	26			20.4	20.5	18.9	18	20.3	36.4	48.1 J	22.4	19.8	17.9	18.3	16.8	16	49.3	18.9	22.5
Chromium (VI) (mg/kg)	0.3																		
Cobalt (mg/kg)	2.3			5.8	6.6	5.7	5.5	6.5	10.1	15.8	6.6	5.7	5.4	5.5 JQ	5.5	5 JQ	14.8	5.7	7.2
Copper (mg/kg)	28			11.1	14.4	9.8	10.3	10.7	25.3	41.5	13	10.4	9.1	9.1	8.3	8	36.3	10.3	13.8
Iron (mg/kg)	5,500			10,900 J	13,400 J	10,900 J	10,400 J	12,800 J	18,500 J	32,600	13,500	11,200	10,700	9,940	10,100	9,570	28,500	11,300	15,000
Lead (mg/kg)	11			5.6 J	1.3 J	1 JQ	0.7 JQ	0.8 JQ	1.3 J	4.1	3.7	2.5	2.1	2	2.1	1.8	6.3	4.3	3.3
Magnesium (mg/kg)				3,750 J	4,600 J	4,290 J	4,440 J	4,610 J	5,920 J	11,000	4,210	3,810	4,140	3,640	3,770	3,520	8,650	3,410	4,590
Manganese (mg/kg)	180			193 J	274 J	202 J	198 J	177 J	401 J	497	225	201	194	189	193	173	526	244	261
Mercury (mg/kg)	1.1			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel (mg/kg)	38			30.1 J	30.5 J	34.3 J	34.5 J	36.9 J	30.6 J	54	35.5	31.8	32.7	32.7	32.8	31.4	65.7	29.7	35
Potassium (mg/kg)				462 JQ	465 JQ	411 JQ	393 JQ	398 JQ	376 JQ	1,360	355 JQ	372 JQ	366 JQ	383 JQ	387 JQ	361 JQ	844	294 JQ	542 JQ
Selenium (mg/kg)	0.52			3.8 U	3.7 U	3.7 U	3.7 U	4.1 U	3.8 U	4.4 U	3.9 U	3.9 U	3.7 U	3.9 U	3.7 U	3.7 U	4.4 U	3.8 U	4.1 U
Silver (mg/kg)	4.2			1.1 U	1.1 U	1.1 U	1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.3 U	1.1 U	1.2 U
Sodium (mg/kg)				176 JQ	211 JQ	215 JQ	232 JQ	149 JQ	198 JQ	422 JQ	145 JQ	120 JQ	133 JQ	126 JQ	145 JQ	122 JQ	268 JQ	202 JQ	144 JQ
Thallium (mg/kg)	0.078			2.2 JQ	2.2 JQ	1.7 JQ	1.5 JQ	2.4 JQ	2.6 JQ	4.7	2.8 U	2.8 U	2.7 U	2.8 U	2.7 U	2.7 U	3.2 U	1.1 JQ	1.2 JQ
Vanadium (mg/kg)	7.8			26.5	31.7	23.7	22.7	30.1	45.9	72.3	31.3	23.3	24.8	20.7	22.3	20.8	61.7	25.1	34.2
Zinc (mg/kg)	46			23.6 J	24 J	21.5 J	20.6 J	23.6 J	34.2 J	63	25.3 J	21 J	19.6 J	19.9 J	19.1 J	18.9 J	56.3 J	21.8 J	27.6 J
Organometallics																			
Tributyltin (mg/kg)	2.3																		
Conventional Chemistry Parameters																			
Dry Weight (Percent)																			
Total Organic Carbon (Percent)		5.2	68.5 J																
Total Solids (Percent)		91.24	73.54 J																
Polycyclic Aromatic Hydrocarbons (PAHs)																			
Acenaphthene (mg/kg)	360	0.023 J	0.11 J		0.0011 U	0.001 U	0.001 U	0.0012 U	0.0011 U	0.0012 U	0.0011 U	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Acenaphthylene (mg/kg)		0.43	2.5 J	0.27	0.0011 U	0.001 U	0.001 U	0.0012 U	0.0011 U	0.0012 U	0.032	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Anthracene (mg/kg)	1,800	0.5	2.3 J	0.16	0.0011 U	0.001 U	0.001 U	0.0012 U	0.0011 U	0.0012 U	0.0011 U	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Benzo(g,h,i)perylene (mg/kg)		2.4	0.51 J	0.52	0.0015	0.0014	0.0019	0.0011 J	0.0012	0.0012 J	0.067	0.00099 J	0.00071 J	0.0012 U	0.0011 U	0.005	0.0013 U	0.0011 U	0.0012 U
Benzo(j)fluoranthene (mg/kg)		0.78	0.86 J																
Dibenzofuran (mg/kg)	7.3			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Fluoranthene (mg/kg)	240	2.8	39 J	0.63	0.0011 U	0.001 U	0.001 U	0.0012 U	0.00068 J	0.0012 U	0.031	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0021	0.0013 U	0.0011 U	0.0012 U
Fluorene (mg/kg)	240	0.12	0.59 J	0.079	0.0011 U	0.001 U	0.001 U	0.0012 U	0.0011 U	0.0012 U	0.0011 U	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Phenanthrene (mg/kg)		2.1	76 J	0.6 J	0.00065 J	0.001 U	0.001 U	0.0012 U	0.00082 J	0.00071 J	0.0013	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Pyrene (mg/kg)	180	4.3	19 J	1.4	0.0006 J	0.001 U	0.001 U	0.0012 U	0.00081 J	0.0012 U	0.039	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0035	0.0013 U	0.0011 U	0.0012 U
1-Methylnaphthalene (mg/kg)	18	0.2	3.7 J																
2-Methylnaphthalene (mg/kg)	24	0.34	9.9 J																
Naphthalene (mg/kg)	3.8	0.64	40 J	0.67 J	0.00071 J	0.0038	0.0027	0.0023	0.0017	0.0015	0.0022	0.00091 J	0.00059 J	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
Benz(a)anthracene (mg/kg)	0.16	2	2.4 J	1.1 U	0.0011 U	0.001 U	0.001 U	0.0012 U	0.0011 U	0.0012 U	0.02 J	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0038	0.0013 U	0.0011 U	0.0012 U
Benzo(a)pyrene (mg/kg)	0.016	2.1	0.75 J	0.57	0.00069 J	0.00053 J	0.00074 J	0.0012 U	0.00056 J	0.0012 U	0.068	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0077	0.0013 U	0.0011 U	0.0012 U
Benzo(b)fluoranthene (mg/kg)	0.16	1.9	2.5 J	0.43	0.0011 UJ	0.001 UJ	0.001 UJ	0.0012 UJ	0.0011 UJ	0.0012 U	0.023 J	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.011 J	0.0013 U	0.0011 U	0.0012 U
Benzo(k)fluoranthene (mg/kg)	1.6	0.89	0.88 J	0.37	0.0011 UJ	0.001 UJ	0.001 UJ	0.0012 UJ	0.0011 UJ	0.0012 U	0.055	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0047	0.0013 U	0.0011 U	0.0012 U
Chrysene (mg/kg)	16	2.4	9.6 J	0.43	0.022 U	0.001 U	0.001 U	0.0012 U	0.00067 J	0.00067 J	0.035	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0069	0.0013 U	0.0011 U	0.0012 U
Dibenzo(a,h)anthracene (mg/kg)	0.016	0.35 J	0.25 J	0.13 J	0.0012	0.0011	0.0016	0.00088 J	0.00092 J	0.00093 J	0.02 J	0.0011 U	0.001 U	0.0012 U	0.0011 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U
Indeno(1,2,3-cd)pyrene (mg/kg)	0.16	1.4	0.47 J	0.39	0.0014	0.0013	0.0018	0.001 J	0.0011	0.0011 J	0.055	0.00066 J	0.001 U	0.0012 U	0.0011 U	0.0035	0.0013 U	0.0011 U	0.0012 U
Total cPAHs TEQ (ND = 0) (mg/kg)	0.016	2.9913 J	1.5554 J	0.706	0.00095	0.00077	0.00108	0.000188 J	0.000769	0.00021 J	0.0857	0.000066 J	ND	ND	ND	0.0101	ND	ND	ND
Total cPAHs TEQ (ND = 1/2 RDL) (mg/kg)	0.016	2.9913 J	1.5554 J	0.761	0.00123	0.000925	0.00124	0.000974 J	0.000934	0.00099 J	0.0857	0.000842 J	ND	ND	ND	0.0101	ND	ND	ND

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	BGW-RE-GP-01 9/3/13 (0-1.5ft)	BGW-RE-HA-01 9/4/13 (5-6.5ft)	MP01 5/14/08 (3.5-5ft)	MP01 5/14/08 (8.5-10ft)	MP01 5/14/08 (13.5-15ft)	MP01 5/14/08 (18.5-20ft)	MP01 5/14/08 (23.5-25ft)	MP01 5/14/08 (28.5-30ft)	MP01 5/14/08 (33.5-35ft)	MP02 5/19/08 (3.5-5ft)	MP02 5/19/08 (8.5-10ft)	MP02 5/19/08 (13.5-15ft)	MP02 5/19/08 (18.5-20ft)	MP02 5/19/08 (23.5-25ft)	MP02 5/19/08 (28.5-30ft)	MP03 5/19/08 (3.5-5ft)	MP03 5/19/08 (8.5-10ft)	MP03 5/19/08 (18.5-20ft)
Other (Non-PAH) Semivolatiles																			
1,1'-Biphenyl (mg/kg)	4.7			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
1,2,4,5-Tetrachlorobenzene (mg/kg)	2.3			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
1,2-Dichlorobenzene (mg/kg)	180				0.0013 U														
1,3-Dichlorobenzene (mg/kg)						0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
1,4-Dichlorobenzene (mg/kg)	2.6					0.0014 U													
1,4-Dioxane (mg/kg)	5.3			0.14 U	0.13 U	0.14 U	0.13 U	0.13 U	0.11 U	0.13 U	0.11 U	0.12 U	0.14 U	0.13 U	0.11 U	0.11 U	0.13 UJ	0.091 UJ	0.11 UJ
2,3,4,6-Tetrachlorophenol (mg/kg)	190			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4,5-Trichlorophenol (mg/kg)	630			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4,6-Trichlorophenol (mg/kg)	6.3			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4-Dichlorophenol (mg/kg)	19			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4-Dimethylphenol (mg/kg)	130			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4-Dinitrophenol (mg/kg)	13			0.11 UJ	0.11 UJ	0.11 UJ	0.11 UJ	0.12 UJ	0.11 UJ	0.12 UJ	0.12 U	0.11 U	0.11 U	0.12 U	0.11 U	0.11 U	0.13 UJ	0.11 UJ	0.12 UJ
2-Chloronaphthalene (mg/kg)	480			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2-Chlorophenol (mg/kg)	39			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2-Methylphenol (mg/kg)	320																		
2-Nitroaniline (mg/kg)	63			0.044 U	0.044 U	0.043 U	0.043 U	0.048 U	0.044 U	0.051 U	0.047 U	0.045 U	0.043 U	0.048 U	0.044 U	0.045 U	0.052 U	0.045 U	0.05 U
2-Nitrophenol (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
3 & 4 Methylphenol (mg/kg)																			
3,3'-Dichlorobenzidine (mg/kg)	1.2			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
3-Nitroaniline (mg/kg)				0.044 U	0.044 U	0.043 U	0.043 U	0.048 U	0.044 U	0.051 U	0.047 U	0.045 U	0.043 U	0.048 U	0.044 U	0.045 U	0.052 U	0.045 U	0.05 U
4,6-Dinitro-2-methylphenol (mg/kg)	0.51			0.044 U	0.044 U	0.043 U	0.043 U	0.048 U	0.044 U	0.051 U	0.047 U	0.045 U	0.043 U	0.048 U	0.044 U	0.045 U	0.052 UJ	0.044 UJ	0.049 UJ
4-Bromophenyl phenyl ether (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
4-Chloro-3-methylphenol (mg/kg)	630			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
4-Chloroaniline (mg/kg)	2.7			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
4-Chlorophenyl phenyl ether (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
4-Methylphenol (mg/kg)	630			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
4-Nitroaniline (mg/kg)	25			0.044 U	0.044 U	0.043 U	0.043 U	0.048 U	0.044 U	0.051 U	0.047 U	0.045 U	0.043 U	0.048 U	0.044 U	0.045 U	0.052 U	0.045 U	0.05 U
4-Nitrophenol (mg/kg)				0.044 U	0.044 U	0.043 U	0.043 U	0.048 U	0.044 U	0.051 U	0.047 U	0.045 U	0.043 U	0.048 U	0.044 U	0.045 U	0.052 U	0.045 U	0.05 U
Acenaphthene (mg/kg)	360			0.022 U															
Acetophenone (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Aniline (mg/kg)	44																		
Atrazine (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Benzaldehyde (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Benzidine (mg/kg)	0.00053			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Benzoic acid (mg/kg)	25,000																		
Benzyl alcohol (mg/kg)	630																		
Benzyl butyl phthalate (mg/kg)	290			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.029	0.023 U	0.023 U	0.019 J	0.017 J	0.015 J	0.022 U	0.016 J	0.022 U	0.025 U
Bis(2-chloro-1-methylethyl) ether (mg/kg)	310			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Bis(2-chloroethoxy)methane (mg/kg)	19			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Bis(2-chloroethyl) ether (mg/kg)	0.23			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Bis(2-ethylhexyl) phthalate (mg/kg)	39			0.18 J	0.082	0.1	0.075	0.093	0.083	0.25	0.29	0.12	0.15	0.18	0.13	0.1	0.24	0.082	0.16
Caprolactam (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.015 J	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Carbazole (mg/kg)				0.026	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Dibenzofuran (mg/kg)	7.3	0.082	2.6 J																
Diethyl phthalate (mg/kg)	5,100			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Dimethyl phthalate (mg/kg)				0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Di-n-butyl phthalate (mg/kg)	630			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.014 J	0.016 J	0.023 U	0.013 J	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Di-n-octyl phthalate (mg/kg)	63			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Hexachlorobenzene (mg/kg)	0.21			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Hexachlorobutadiene (mg/kg)	1.2																		
Hexachlorocyclopentadiene (mg/kg)	0.18			0.054 UJ	0.054 UJ	0.054 UJ	0.054 UJ	0.06 UJ	0.055 UJ	0.062 UJ	0.059 U	0.057 U	0.054 U	0.06 U	0.055 U	0.056 U	0.065 U	0.056 UJ	0.061 UJ
Hexachloroethane (mg/kg)	1.8						0.0025 U	0.0025 U	0.0022 U	0.0026 U	0.0023 U	0.0025 U	0.0027 U	0.0026 U	0.0023 U	0.0023 U	0.0025 U	0.0018 U	0.0022 U
Isophorone (mg/kg)	570			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Nitrobenzene (mg/kg)	5.1																		
N-Nitrosodimethylamine (mg/kg)	0.002			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
N-Nitroso-di-n-propylamine (mg/kg)	0.078			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
N-Nitrosodiphenylamine (mg/kg)	110			0.022 U	0.022 UJ	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
Pentachlorophenol (mg/kg)	1			0.022 UJ	0.0022 U	0.0021 U	0.0021 U	0.0024 U	0.0022 U	0.0025 U	0.0023 U	0.00096 J	0.0021 U	0.0024 U	0.0022 U	0.0022 U	0.026 UJ	0.022 UJ	0.024 UJ
Phenol (mg/kg)	1,900			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U
2,4-Dinitrotoluene (mg/kg)	1.7																		
2,6-Dinitrotoluene (mg/kg)	0.36																		
2-Methylnaphthalene (mg/kg)	24			0.047	0.0011 U	0.001 U	0.001 U	0.0012 U	0.0006 J	0.0012 U	0.0011 U	0.0011 U	0.001 U	0.0012 U	0.0011 U				

Bremerton Gas Works Superfund Site
Bremerton, Washington

Volatile Organic Compounds (VOC)																				
1,1,1,2-Tetrachloroethane (mg/kg)	2			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1,1-Trichloroethane (mg/kg)	810			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1,2 - Trichlorotrifluoroethane (mg/kg)	4,000			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1,2,2-Tetrachloroethane (mg/kg)	0.6			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1,2-Trichloroethane (mg/kg)	0.15			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1-Dichloroethane (mg/kg)	3.6			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,1-Dichloroethene (mg/kg)	23			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U		0.0011 U	
1,1-Dichloropropene (mg/kg)																				
1,2,3-Trichlorobenzene (mg/kg)	6.3			0.0072 U	0.0064 U	0.0071 U	0.0063 U	0.0063 U	0.0055 U	0.0065 U	0.0057 U	0.0062 U	0.0068 U	0.0064 U	0.0057 U	0.0057 U	0.0013 U	0.00091 U	0.0011 U	
1,2,3-Trichloropropane (mg/kg)	0.0051			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,2,4-Trichlorobenzene (mg/kg)	5.8			0.0072 U	0.0064 U	0.0071 U	0.0063 U	0.0063 U	0.0055 U	0.0065 U	0.0057 U	0.0062 U	0.0068 U	0.0064 U	0.0057 U	0.0057 U	0.0013 U	0.00091 U	0.0011 U	
1,2,4-Trimethylbenzene (mg/kg)	5.8			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U	
1,2-Dibromo-3-chloropropane (mg/kg)	0.0053			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,2-Dibromoethane (EDB) (mg/kg)	0.036			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,2-Dichlorobenzene (mg/kg)	180			0.0014 U		0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,2-Dichloroethane (EDC) (mg/kg)	0.46			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,2-Dichloropropane (mg/kg)	1			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U		0.0011 U	
1,3,5-Trimethylbenzene (mg/kg)	78			0.022 U	0.022 U	0.022 U	0.021 U	0.024 U	0.022 U	0.025 U	0.023 U	0.023 U	0.022 U	0.024 U	0.022 U	0.022 U	0.026 U	0.022 U	0.025 U	
1,3-Dichlorobenzene (mg/kg)				0.0014 U	0.0013 U															
1,3-Dichloropropane (mg/kg)	160																			
1,4-Dichlorobenzene (mg/kg)	2.6			0.0014 U	0.0013 U		0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
1,4-Difluorobenzene (mg/kg)																				
2,2-Dichloropropane (mg/kg)																				
2-Butanone (mg/kg)	2,700			0.0072 U	0.0064 U	0.0071 U	0.0063 U	0.0063 U	0.0055 U	0.0065 U	0.0057 U	0.0062 U	0.0068 U	0.0064 U	0.0057 U	0.0057 U	0.0063 U	0.0046 U	0.0054 U	
2-Chlorotoluene (mg/kg)	160																			
2-Hexanone (mg/kg)	20			0.0072 U	0.0064 U	0.0071 U	0.0063 U	0.0063 U	0.0055 U	0.0065 U	0.0057 U	0.0062 U	0.0068 U	0.0064 U	0.0057 U	0.0057 U	0.0063 U	0.0046 U	0.0054 U	
4-Chlorotoluene (mg/kg)	160																			
4-Methyl-2-pentanone (mg/kg)	3,300			0.0072 U	0.0064 U	0.0071 U	0.0063 U	0.0063 U	0.0055 U	0.0065 U	0.0057 U	0.0062 U	0.0068 U	0.0064 U	0.0057 U	0.0057 U	0.0063 U	0.0046 U	0.0054 U	
Acetone (mg/kg)	6,100			0.026	0.011	0.0071 U	0.0063 U	0.021	0.0095	0.02	0.0057 U	0.0062 U	0.0068 U	0.017	0.016	0.016	0.0063 U	0.0046 U	0.0065	
Benzene (mg/kg)	1.2			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Bromobenzene (mg/kg)	29																			
Bromochloromethane (mg/kg)	15			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Bromodichloromethane (mg/kg)	0.29			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Bromoform (mg/kg)	19			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Bromomethane (mg/kg)	0.68			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U		
Carbon disulfide (mg/kg)	77			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Carbon tetrachloride (mg/kg)	0.65			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Chlorobenzene (mg/kg)	28			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Chlorobenzene-d5 (mg/kg)																				
Chloroethane (mg/kg)	1,400			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Chloroform (mg/kg)	0.32			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Chloromethane (mg/kg)	11			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
cis-1,2-Dichloroethene (DCE) (mg/kg)	16			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
cis-1,3-Dichloropropene (mg/kg)				0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Cyclohexane (mg/kg)	650			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Dibromochloromethane (mg/kg)	8.3			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Dibromomethane (mg/kg)	2.4																			
Dichlorodifluoromethane (mg/kg)	8.7			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Ethylbenzene (mg/kg)	5.8			0.0014 U	0.0013 U	0.0067	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Hexachlorobutadiene (mg/kg)	1.2			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Hexachloroethane (mg/kg)	1.8			0.0029 U	0.0026 U	0.0029 U														
Isopropylbenzene (mg/kg)	190			0.0014 U	0.0013 U	0.0017	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Methyl acetate (mg/kg)	7,800			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Methyl tert-butyl ether (MTBE) (mg/kg)	47			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Methylcyclohexane (mg/kg)				0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	
Methylene chloride (mg/kg)	35			0.00069 J	0.00058 J	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0028	0.0027	0.0016	0.0017	0.0013	0.0011 J	0.0013 U	0.00091 U	0.0011 U	
n-Butylbenzene (mg/kg)	390																			
n-Hexane (mg/kg)	61																			
n-Propylbenzene (mg/kg)	380																			
Pentafluorobenzene (mg/kg)																				
p-Isopropyltoluene (mg/kg)																				
sec-Butylbenzene (mg/kg)	780																			
Styrene (mg/kg)	600			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U	

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	BGW-RE-GP-01 9/3/13 (0-1.5ft)	BGW-RE-HA-01 9/4/13 (5-6.5ft)	MP01 5/14/08 (3.5-5ft)	MP01 5/14/08 (8.5-10ft)	MP01 5/14/08 (13.5-15ft)	MP01 5/14/08 (18.5-20ft)	MP01 5/14/08 (23.5-25ft)	MP01 5/14/08 (28.5-30ft)	MP01 5/14/08 (33.5-35ft)	MP02 5/19/08 (3.5-5ft)	MP02 5/19/08 (8.5-10ft)	MP02 5/19/08 (13.5-15ft)	MP02 5/19/08 (18.5-20ft)	MP02 5/19/08 (23.5-25ft)	MP02 5/19/08 (28.5-30ft)	MP03 5/19/08 (3.5-5ft)	MP03 5/19/08 (8.5-10ft)	MP03 5/19/08 (18.5-20ft)
tert-Butylbenzene (mg/kg)	780																		
Tetrachloroethene (PCE) (mg/kg)	8.1			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 UJ
Toluene (mg/kg)	490			0.0014 J	0.00038 J	0.00078 J	0.00046 J	0.0012 J	0.00048 J	0.00078 J	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00026 J	0.00099 J
trans-1,2-Dichloroethene (mg/kg)	160			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
trans-1,3-Dichloropropene (mg/kg)				0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
Trichloroethene (TCE) (mg/kg)	0.41			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 UJ
Trichlorofluoromethane (mg/kg)	2,300			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
Vinyl chloride (mg/kg)	0.059			0.0014 U	0.0013 U	0.0014 U	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 U
m,p-Xylenes (mg/kg)				0.0014 U	0.0013 U	0.043	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 UJ
o-Xylene (mg/kg)	65			0.0014 U	0.0013 U	0.011	0.0013 U	0.0013 U	0.0011 U	0.0013 U	0.0011 U	0.0012 U	0.0014 U	0.0013 U	0.0011 U	0.0011 U	0.0013 U	0.00091 U	0.0011 UJ
Xylenes (total) (mg/kg)	58																		
Polychlorinated Biphenyls (PCBs)																			
Aroclor 1016 (mg/kg)	0.41																		
Aroclor 1221 (mg/kg)	0.2																		
Aroclor 1232 (mg/kg)	0.17																		
Aroclor 1242 (mg/kg)	0.23																		
Aroclor 1248 (mg/kg)	0.23																		
Aroclor 1254 (mg/kg)	0.12																		
Aroclor 1260 (mg/kg)	0.24																		
Aroclor 1262 (mg/kg)																			
Aroclor 1268 (mg/kg)																			

Notes

Concentrations in shaded cells indicate value exceeds Soil PRG.
Where a sample has multiple results for a given analyte (tested for in multiple methods) the highest detected value is shown. Where all results were non-detects, the result with the lowest detection limit is shown.
J = Analyte was positively identified. The reported result is an estimate.
JQ = Approximate value due to quality control problems.
PRG = preliminary remediation goal
QP = Hydrocarbon result partly due to individual peak(s) in quantitation range.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MP04 5/13/08 (3.5-5ft)	MP04 5/13/08 (8.5-10ft)	MP04 5/13/08 (13.5-15ft)	MP04 5/13/08 (18.5-20ft)	MP04 5/13/08 (25-26.5ft)	MP04 5/12/08 (35-37.5ft)	MP04 5/13/08 (35-37.5ft)	MP04 5/13/08 (38.5-40ft)	MW-1 5/21/07 (5-6.5ft)	MW-1 5/21/07 (35-36.5ft)	MW-2 5/21/07 (10-11.5ft)	MW-2 5/21/07 (40-41.5ft)	MW-3 5/22/07 (5-6.5ft)	MW-3 5/22/07 (25-26.5ft)	MW-4 5/23/07 (15-16.5ft)	MW-4 5/23/07 (30-31.5ft)	MW-5 5/24/07 (10-11.5ft)	MW-5 5/24/07 (20-21.5ft)
Total Petroleum Hydrocarbons (TPH)																			
Gasoline Range Hydrocarbons (mg/kg)		5 JQ	7 U	6 U	6 U	6 U	12 U	6 U	6 U	13.2 U	10.3 U	21.9	12.3 U	645	10.8 U	185	635	5.62 U	5.69 U
Diesel Range Hydrocarbons (mg/kg)			25 U	25 U	25 U	25 U	25 U	25 U	25 U	13.2 U	12.1 U	617	12.3 U	6,710 QP	10.7 U	2,960 QP	4,370	402 QP	11.6 U
Oil Range Hydrocarbons (mg/kg)			50 U	50 U	50 U	50 U	50 U	50 U	50 U	32.9 U	30.3 U	965	30.7 U	2,250 QP	26.6 U	412	274 U	232 QP	29.0 U
Metals																			
Aluminum (mg/kg)	7,700	13,400 J	8,050 J	16,500 J	8,950 J	20,300 J	7,900		6,370										
Antimony (mg/kg)	0.27						6.8 UJ		7.1 UJ	1.98 U	1.82 U	1.69 U	1.84 U	1.80 U	1.62 U	1.63 U	1.53 U	1.86 U	1.53 U
Arsenic (mg/kg)	0.68	1.5	0.8	2	1	3.6	0.6		0.7	3.49	1.35	3.18	0.797	48.4	1.27	2.58	4.80	3.81	0.833
Barium (mg/kg)	330	57.4 J	34.7 J	83.1 J	35.7 J	91.2 J	27.3		23.9										
Beryllium (mg/kg)	16	0.3 JQ	0.2 JQ	0.4 JQ	0.2 JQ	0.4 JQ	0.2 JQ		0.1 JQ	0.661 U	0.607 U	0.563 U	0.613 U	0.600 U	0.540 U	0.544 U	0.509 U	0.620 U	0.511 U
Cadmium (mg/kg)	0.36	0.5 JQ	0.2 JQ	0.7	0.3 JQ	0.9	0.2 JQ		0.2 JQ	0.661 U	0.607 U	0.563 U	0.613 U	0.600 U	0.540 U	0.544 U	0.509 U	0.620 U	0.511 U
Calcium (mg/kg)		4,070	3,050	6,730	2,740	6,740	3,770		2,960										
Chromium (Total) (mg/kg)	26	26.6	21.6	42.6	19.2	48.4	21.7 J		14.6 J	39.5	19.8	35.0	24.7	26.3	23.9	31.8	46.5	33.1	26.3
Chromium (VI) (mg/kg)	0.3									1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	1.1 U	1.1 U	1.0 U	1.1 U	1.2 U
Cobalt (mg/kg)	2.3	9.2	5.5	13.3	5.5 JQ	19	5.8		4.9 JQ										
Copper (mg/kg)	28	16.9	11.2	33.4	11.8	43.1	12.2		11.7	24.8	8.01	18.4	10.1	37.8	11.0	23.3	22.0	79.1	11.1
Iron (mg/kg)	5,500	17,800 J	11,200 J	27,100 J	11,700 J	31,700 J	12,600		10,100										
Lead (mg/kg)	11	2.4 J	0.6 JQ	3.6 J	0.8 JQ	4.5 J	0.7 JQ		1.2 U	3.86	1.58	41.3	1.34	87.0	1.54	13.9	2.12	131	1.44
Magnesium (mg/kg)		4,930	3,960 J	8,530 J	4,100 J	9,430 J	4,580		3,650										
Manganese (mg/kg)	180	375 J	197 J	530 J	208 J	597 J	217		179										
Mercury (mg/kg)	1.1	0.1 U	0.1 U	0.1 JQ	0.1 U	0.1 JQ	0.1 U		0.1 U	0.134 U	0.111 U	0.107 U	0.131 U	0.129 U	0.0976 U	0.101 U	0.0937 U	1.62	0.0941 U
Nickel (mg/kg)	38	36.8 J	32.5 J	50.8 J	31 J	66.3 J	28.4		21.2	48.3	32.5	40.6	32.0	37.5	36.2	38.1	44.6	61.1	34.6
Potassium (mg/kg)		531 JQ	371 JQ	1,110	400 JQ	1,240	372 JQ		344 JQ										
Selenium (mg/kg)	0.52	4 U	3.8 U	4.2 U	3.9 U	4.4 U	4 U		4.1 U	0.661 U	0.607 U	0.563 U	0.613 U	0.600 U	0.540 U	0.544 U	0.509 U	0.620 U	0.511 U
Silver (mg/kg)	4.2	1.1 U	1.1 U	1.2 U	1.1 U	1.3 U	1.1 U		1.2 U	0.661 U	0.607 U	0.563 U	0.613 U	0.600 U	0.540 U	0.544 U	0.509 U	0.620 U	0.511 U
Sodium (mg/kg)		254 JQ	182 JQ	417 JQ	144 JQ	303 JQ	209 JQ		230 JQ										
Thallium (mg/kg)	0.078	3	1.8 JQ	4.3	1.9 JQ	4.5	2.4 JQ		1.6 JQ	0.661 U	0.607 U	0.563 U	0.613 U	0.600 U	0.540 U	0.544 U	0.509 U	0.620 U	0.511 U
Vanadium (mg/kg)	7.8	40.2	25.3	61.2	24.9	69.3	27.7		23.6										
Zinc (mg/kg)	46	35.1 J	22.3 J	53.7 J	23.1 J	68.2 J	28.6		19.3	61.7	23.9	44.3	24.7	166	24.9	67.2	34.8	204	27.0
Organometallics																			
Tributyltin (mg/kg)	2.3									0.00074 U	0.0008 U			0.00079 U	0.00069 U	0.0014 U	0.0014 U	0.0016 U	0.0015 U
Conventional Chemistry Parameters																			
Dry Weight (Percent)										75.7	82.4	88.8	81.6	83.3	92.6	87.5	91.0	80.6	86.6
Total Organic Carbon (Percent)																			
Total Solids (Percent)										75.7	82.4	88.8	81.6	83.3	92.6	87.5	91.0		
Polycyclic Aromatic Hydrocarbons (PAHs)																			
Acenaphthene (mg/kg)	360	0.0076	0.0011 U	3.4 J	0.0011 U	0.0012 J	0.0015		0.0011 U	0.0132 U	0.0120 U	0.671	0.0123 U	18.5	0.0108	7.31	22.0	0.612 U	0.0205
Acenaphthylene (mg/kg)		0.0018	0.0011 U	0.88 J	0.0011 U	0.0011 J	0.0019		0.0011 U	0.0132 U	0.0120 U	4.36	0.0123 U	233	0.0151	5.16	1.49	4.52	0.0114 U
Anthracene (mg/kg)	1,800	0.0056	0.0011 U	0.33	0.0011 U	0.0014	0.0012		0.0011 U	0.0132 U	0.0120 U	2.36	0.0123 U	274	0.0108 U	29.9	13.0	11.1	0.0198
Benzo(g,h,i)perylene (mg/kg)		0.0028	0.0017	0.89	0.0013	0.0029	0.0027		0.0014	0.0132 U	0.0120 U	10.6	0.0123 U	31.9	0.0108 U	9.03	4.04	14.6	0.0114 U
Benzo(j)fluoranthene (mg/kg)																			
Dibenzofuran (mg/kg)	7.3	0.023 U	0.023 U	0.31 J	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U
Fluoranthene (mg/kg)	240	0.0091	0.0011 U	2.9 J	0.0011 U	0.0036	0.0028		0.0011 U	0.0132 U	0.0120 U	15.0	0.0123 U	176	0.0108 U	56.2	23.6	68.3	0.0122
Fluorene (mg/kg)	240	0.005	0.0011 U	2 J	0.0011 U	0.0012 J	0.0013		0.0011 U	0.0132 U	0.0120 U	1.27	0.0123 U	182	0.0130	23.8	15.7	4.57	0.0114 U
Phenanthrene (mg/kg)		0.021	0.00083 J	13 J	0.00061 J	0.0053	0.004		0.0011 U	0.0132 U	0.0120 U	9.16	0.0123 U	480	0.0122	114	55.2	59.7	0.0843
Pyrene (mg/kg)	180	0.016	3.6 J	0.65	0.0011 U	0.0048	0.0039		0.0011 U	0.0132 U	0.0120 U	27.3	0.0123 U	192	0.0108 U	93.8	34.0	95.7	0.0137
1-Methylnaphthalene (mg/kg)	18									0.0132 U	0.0120 U	1.23	0.0123 U	236	0.0144	21.2	51.8	0.979	0.0228
2-Methylnaphthalene (mg/kg)	24									0.0132 U	0.0120 U	2.96	0.0123 U	404	0.0158	35.1	91.0	1.63	0.0114 U
Naphthalene (mg/kg)	3.8	270	0.00095 J	17 J	0.001 J	0.013 J	0.005		0.0011 U	0.00607 U	0.00552 U	4.62	0.00576 U	708	0.0360	63.9	79.8	2.08	0.0319
Benz(a)anthracene (mg/kg)	0.16	0.0041	0.0011 U	0.35 J	0.0011 U	0.0022	0.0011 J		0.0011 U	0.0132 U	0.0120 U	5.44	0.0123 U	59.7	0.0108 U	11.8	5.03	21.0	0.0114 U
Benzo(a)pyrene (mg/kg)	0.016	0.0041	0.001 J	1.7	0.00065 J	0.0025	0.0019		0.0011 U	0.0132 U	0.0120 U	11.5	0.0123 U	58.9	0.0108 U	11.9	6.81	16.7	0.0114 U
Benzo(b)fluoranthene (mg/kg)	0.16	0.0018 J	0.0011 UJ	0.64	0.0011 UJ	0.0014 J	0.00085 J		0.0011 U	0.0132 U	0.0120 U	6.94	0.0123 U	26.1	0.0108 U	5.93	2.62	12.5	0.0114 U
Benzo(k)fluoranthene (mg/kg)	1.6	0.0022 J	0.00056 J	0.67	0.0011 UJ	0.0016 J	0.001 J		0.0011 U	0.0176	0.0120 U	6.00	0.0123 U	34.9	0.0130	7.93	3.83	14.6	0.0129
Chrysene (mg/kg)	16	0.0052	0.00073 J	0.28 J	0.0011 U	0.003	0.0016		0.0011 U	0.0132 U	0.0120 U	9.17	0.0123 U	69.2	0.0108 U	13.7	6.66	28.9	0.0114 U
Dibenzo(a,h)anthracene (mg/kg)	0.016	0.0019	0.0014	0.24 J	0.0011	0.0026	0.0022		0.00096 J	0.0132 U	0.0120 U	2.09	0.0123 U	8.48	0.0108 U	2.35	1.28	4.37	0.0114 U
Indeno(1,2,3-cd)pyrene (mg/kg)	0.16	0.0026	0.0016	0.74	0.0013	0.0028	0.0025		0.001 J	0.0132 U	0.0120 U	6.49	0.0123 U	26.8	0.0108 U	6.31	2.91	11.1	0.0114 U
Total cPAHs TEQ (ND = 0) (mg/kg)	0.016	0.00541	0.00136	1.97	0.00089	0.00359	0.00268		0.000196 J	0.00176	ND	14.3	ND	75.2	0.0013	15.5	8.44	23.3	0.00129
Total cPAHs TEQ (ND = 1/2 RDL) (mg/kg)	0.016	0.00541	0.00147	1.97	0.00106	0.00359	0.00268		0.000917 J	0.0111	ND	14.3	ND	75.2	0.00891	15.5	8.44	23.3	0.00933

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MP04 5/13/08 (3.5-5ft)	MP04 5/13/08 (8.5-10ft)	MP04 5/13/08 (13.5-15ft)	MP04 5/13/08 (18.5-20ft)	MP04 5/13/08 (25-26.5ft)	MP04 5/12/08 (35-37.5ft)	MP04 5/13/08 (35-37.5ft)	MP04 5/13/08 (38.5-40ft)	MW-1 5/21/07 (5-6.5ft)	MW-1 5/21/07 (35-36.5ft)	MW-2 5/21/07 (10-11.5ft)	MW-2 5/21/07 (40-41.5ft)	MW-3 5/22/07 (5-6.5ft)	MW-3 5/22/07 (25-26.5ft)	MW-4 5/23/07 (15-16.5ft)	MW-4 5/23/07 (30-31.5ft)	MW-5 5/24/07 (10-11.5ft)	MW-5 5/24/07 (20-21.5ft)	
Other (Non-PAH) Semivolatiles																				
1,1'-Biphenyl (mg/kg)	4.7	0.023 U	0.023 U	0.3 J	0.022 U	0.025 U	0.024 U		0.023 U											
1,2,4,5-Tetrachlorobenzene (mg/kg)	2.3	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
1,2-Dichlorobenzene (mg/kg)	180																			
1,3-Dichlorobenzene (mg/kg)		0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U											
1,4-Dichlorobenzene (mg/kg)	2.6																			
1,4-Dioxane (mg/kg)	5.3	0.1 U	0.15 U	0.12 U	0.13 U	0.12 U	0.12 U		0.13 U											
2,3,4,6-Tetrachlorophenol (mg/kg)	190	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
2,4,5-Trichlorophenol (mg/kg)	630	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2,4,6-Trichlorophenol (mg/kg)	6.3	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2,4-Dichlorophenol (mg/kg)	19	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2,4-Dimethylphenol (mg/kg)	130	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2,4-Dinitrophenol (mg/kg)	13	0.11 UJ	0.11 UJ	0.12 UJ	0.11 UJ	0.12 UJ	0.12 UJ		0.11 UJ	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
2-Chloronaphthalene (mg/kg)	480	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2-Chlorophenol (mg/kg)	39	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2-Methylphenol (mg/kg)	320									0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2-Nitroaniline (mg/kg)	63	0.046 U	0.045 U	0.048 U	0.045 U	0.05 U	0.047 U		0.047 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
2-Nitrophenol (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
3 & 4 Methylphenol (mg/kg)										0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
3,3'-Dichlorobenzidine (mg/kg)	1.2	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	6.61 U	5.99 U	28.0 U	6.13 U	1,500 U	5.40 U	57.7 U	106 U	61.2 U	5.70 U	
3-Nitroaniline (mg/kg)		0.046 U	0.045 U	0.048 U	0.045 U	0.05 U	0.047 U		0.047 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
4,6-Dinitro-2-methylphenol (mg/kg)	0.51	0.046 U	0.045 U	0.048 U	0.045 U	0.05 U	0.047 U		0.047 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
4-Bromophenyl phenyl ether (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
4-Chloro-3-methylphenol (mg/kg)	630	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
4-Chloroaniline (mg/kg)	2.7	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
4-Chlorophenyl phenyl ether (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
4-Methylphenol (mg/kg)	630	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
4-Nitroaniline (mg/kg)	25	0.046 U	0.045 U	0.048 U	0.045 U	0.05 U	0.047 U		0.047 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
4-Nitrophenol (mg/kg)		0.046 U	0.045 U	0.048 U	0.045 U	0.05 U	0.047 U		0.047 U	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
Acenaphthene (mg/kg)	360																			
Acetophenone (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
Aniline (mg/kg)	44									0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Atrazine (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
Benzaldehyde (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
Benzidine (mg/kg)	0.00053	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
Benzoic acid (mg/kg)	25,000									1.32 U	1.20 U	5.59 U	1.23 U	299 U	1.08 U	11.5 U	21.3 U	12.2 U	1.14 U	
Benzyl alcohol (mg/kg)	630									0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Benzyl butyl phthalate (mg/kg)	290	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Bis(2-chloro-1-methylethyl) ether (mg/kg)	310	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Bis(2-chloroethoxy)methane (mg/kg)	19	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Bis(2-chloroethyl) ether (mg/kg)	0.23	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Bis(2-ethylhexyl) phthalate (mg/kg)	39	0.1	0.1	0.024 U	0.082	0.24	0.069		0.16	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Caprolactam (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
Carbazole (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Dibenzofuran (mg/kg)	7.3																			
Diethyl phthalate (mg/kg)	5,100	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Dimethyl phthalate (mg/kg)		0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Di-n-butyl phthalate (mg/kg)	630	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Di-n-octyl phthalate (mg/kg)	63	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Hexachlorobenzene (mg/kg)	0.21	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Hexachlorobutadiene (mg/kg)	1.2																			
Hexachlorocyclopentadiene (mg/kg)	0.18	0.057 UJ	0.057 UJ	0.06 UJ	0.056 UJ	0.062 UJ	0.059 UJ		0.059 UJ	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
Hexachloroethane (mg/kg)	1.8	0.002 U	0.003 U	0.0024 U	0.0026 U	0.0024 U	0.0024 U		0.0026 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Isophorone (mg/kg)	570	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Nitrobenzene (mg/kg)	5.1									0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
N-Nitrosodimethylamine (mg/kg)	0.002	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U											
N-Nitroso-di-n-propylamine (mg/kg)	0.078	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
N-Nitrosodiphenylamine (mg/kg)	110	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
Pentachlorophenol (mg/kg)	1	0.0023 U	0.0022 U	0.024 U	0.0022 U	0.0036	0.0023 U		0.00081 J	0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
Phenol (mg/kg)	1,900	0.023 U	0.023 U	0.024 U	0.022 U	0.025 U	0.024 U		0.023 U	0.436 U	0.395 U	1.85 U	0.404 U	98.7 U	0.356 U	3.81 U	7.02 U	4.04 U	0.376 U	
2,4-Dinitrotoluene (mg/kg)	1.7									0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
2,6-Dinitrotoluene (mg/kg)	0.36									0.661 U	0.599 U	2.80 U	0.613 U	150 U	0.540 U	5.77 U	10.6 U	6.12 U	0.570 U	
2-Methylnaphthalene (mg/kg)	24	0.0054	0.0011 U	11 J	0.0011 U	0.0053	0.0023		0.0011 U											

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MP04 5/13/08 (3.5-5ft)	MP04 5/13/08 (8.5-10ft)	MP04 5/13/08 (13.5-15ft)	MP04 5/13/08 (18.5-20ft)	MP04 5/13/08 (25-26.5ft)	MP04 5/12/08 (35-37.5ft)	MP04 5/13/08 (35-37.5ft)	MP04 5/13/08 (38.5-40ft)	MW-1 5/21/07 (5-6.5ft)	MW-1 5/21/07 (35-36.5ft)	MW-2 5/21/07 (10-11.5ft)	MW-2 5/21/07 (40-41.5ft)	MW-3 5/22/07 (5-6.5ft)	MW-3 5/22/07 (25-26.5ft)	MW-4 5/23/07 (15-16.5ft)	MW-4 5/23/07 (30-31.5ft)	MW-5 5/24/07 (10-11.5ft)	MW-5 5/24/07 (20-21.5ft)	
Volatile Organic Compounds (VOC)																				
1,1,1,2-Tetrachloroethane (mg/kg)	2	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,1,1-Trichloroethane (mg/kg)	810	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00152 U	0.00138 U	0.101 U	0.00144 U	0.553 U	0.00145 U	0.417 U	0.0833 U	0.112 U	0.0014 U	
1,1,2 - Trichlorotrifluoroethane (mg/kg)	4,000	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U											
1,1,2,2-Tetrachloroethane (mg/kg)	0.6	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,1,2-Trichloroethane (mg/kg)	0.15	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.000759 U	0.00069 U	0.101 U	0.00072 U	0.553 U	0.000725 U	0.417 U	0.0833 U	0.112 U	0.0007 U	
1,1-Dichloroethane (mg/kg)	3.6	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00121 U	0.0011 U	0.101 U	0.00115 U	0.553 U	0.00116 U	0.417 U	0.0833 U	0.112 U	0.00112 U	
1,1-Dichloroethene (mg/kg)	23	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00182 U	0.00165 U	0.101 U	0.00173 U	0.553 U	0.00174 U	0.417 U	0.0833 U	0.112 U	0.00168 U	
1,1-Dichloropropene (mg/kg)										0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,2,3-Trichlorobenzene (mg/kg)	6.3	0.005 U	0.0075 U	0.006 U	0.0065 U	0.00013 J	0.0061 U		0.0064 U	0.00607 U	0.00552 U	0.504 U	0.00576 U	2.77 U	0.0058 U	2.09 U	0.416 U	0.562 U	0.0056 U	
1,2,3-Trichloropropane (mg/kg)	0.0051	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,2,4-Trichlorobenzene (mg/kg)	5.8	0.005 U	0.0075 U	0.006 U	0.0065 U	0.00014 J	0.0061 U		0.0064 U	0.00607 U	0.00552 U	0.504 U	0.00576 U	2.77 U	0.0058 U	2.09 U	0.416 U	0.562 U	0.0056 U	
1,2,4-Trimethylbenzene (mg/kg)	5.8	0.023 U	0.023 U	0.042	0.022 U	0.025 U	0.024 U		0.023 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	6.70	0.0029 U	1.92	8.31	0.112 U	0.0028 U	
1,2-Dibromo-3-chloropropane (mg/kg)	0.0053	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00607 U	0.00552 U	0.504 U	0.00576 U	2.77 U	0.0058 U	2.09 U	0.416 U	0.562 U	0.0056 U	
1,2-Dibromoethane (EDB) (mg/kg)	0.036	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,2-Dichlorobenzene (mg/kg)	180	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,2-Dichloroethane (EDC) (mg/kg)	0.46	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.000759 U	0.00069 U	0.101 U	0.00072 U	0.553 U	0.000725 U	0.417 U	0.0833 U	0.112 U	0.0007 U	
1,2-Dichloropropane (mg/kg)	1	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,3,5-Trimethylbenzene (mg/kg)	78	0.023 U	0.023 U	0.14	0.022 U	0.025 U	0.024 U		0.023 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	2.41	0.0029 U	0.426	0.0833 U	0.112 U	0.0028 U	
1,3-Dichlorobenzene (mg/kg)										0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,3-Dichloropropane (mg/kg)	160									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,4-Dichlorobenzene (mg/kg)	2.6	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
1,4-Difluorobenzene (mg/kg)												2.00								
2,2-Dichloropropane (mg/kg)										0.00607 U	0.00552 U	0.101 U	0.00576 U	0.553 U	0.0058 U	0.417 U	0.0833 U	0.112 U	0.0056 U	
2-Butanone (mg/kg)	2,700	0.005 U	0.0075 U	0.006 U	0.0065 U	0.0061 U	0.0061 U		0.0064 U	0.00911 U	0.00827 U	1.01 U	0.00864 U	5.53 U	0.0087 U	4.17 U	0.833 U	1.12 U	0.0084 U	
2-Chlorotoluene (mg/kg)	160									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
2-Hexanone (mg/kg)	20	0.005 UJ	0.0075 UJ	0.006 UJ	0.0065 UJ	0.0061 UJ	0.0061 UJ		0.0064 UJ	0.0121 U	0.011 U	1.01 U	0.0115 U	5.53 U	0.0116 U	4.17 U	0.833 U	1.12 U	0.0112 U	
4-Chlorotoluene (mg/kg)	160									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
4-Methyl-2-pentanone (mg/kg)	3,300	0.005 U	0.0075 U	0.006 U	0.0065 U	0.0061 U	0.0061 U		0.0064 U	0.0121 U	0.011 U	1.01 U	0.0115 U	5.53 U	0.0116 U	4.17 U	0.833 U	1.12 U	0.0112 U	
Acetone (mg/kg)	6,100	0.028	0.013	0.006 U	0.0097	0.0061 U	0.016		0.018	0.0182 U	0.0165 U	1.01 U	0.0173 U	5.53 U	0.0233	4.17 U	0.833 U	1.12 U	0.0168 U	
Benzene (mg/kg)	1.2	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.000911 U	0.000827 U	0.139	0.000864 U	1.93	0.00087 U	0.417 U	0.0167 U	0.0416	0.00779	
Bromobenzene (mg/kg)	29									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Bromochloromethane (mg/kg)	15	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Bromodichloromethane (mg/kg)	0.29	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Bromoform (mg/kg)	19	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Bromomethane (mg/kg)	0.68	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00607 U	0.00552 U	0.101 U	0.00576 U	0.553 U	0.0058 U	0.417 U	0.0833 U	0.112 U	0.0056 U	
Carbon disulfide (mg/kg)	77	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00182 U	0.00165 U	0.101 U	0.00173 U	0.553 U	0.00174 U	0.417 U	0.0833 U	0.112 U	0.00168 U	
Carbon tetrachloride (mg/kg)	0.65	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Chlorobenzene (mg/kg)	28	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00121 U	0.0011 U	0.101 U	0.00115 U	0.553 U	0.00116 U	0.417 U	0.0833 U	0.112 U	0.00112 U	
Chlorobenzene-d5 (mg/kg)												2.00								
Chloroethane (mg/kg)	1,400	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Chloroform (mg/kg)	0.32	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00152 U	0.00138 U	0.101 U	0.00144 U	0.553 U	0.00145 U	0.417 U	0.0833 U	0.112 U	0.0014 U	
Chloromethane (mg/kg)	11	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00607 U	0.00552 U	0.504 U	0.00576 U	2.77 U	0.0058 U	2.09 U	0.416 U	0.562 U	0.0056 U	
cis-1,2-Dichloroethene (DCE) (mg/kg)	16	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00182 U	0.00165 U	0.101 U	0.00173 U	0.553 U	0.00174 U	0.417 U	0.0833 U	0.112 U	0.00168 U	
cis-1,3-Dichloropropene (mg/kg)		0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Cyclohexane (mg/kg)	650	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U											
Dibromochloromethane (mg/kg)	8.3	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Dibromomethane (mg/kg)	2.4									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Dichlorodifluoromethane (mg/kg)	8.7	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U	
Ethylbenzene (mg/kg)	5.8	0.086 J	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00243 U	0.00221 U	0.295	0.0023 U	3.29	0.00232 U	0.893	1.80	0.112 U	0.011	
Hexachlorobutadiene (mg/kg)	1.2	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00607 U	0.00552 U	0.504 U	0.00576 U	2.77 U	0.0058 U	2.09 U	0.416 U	0.562 U	0.0056 U	
Hexachloroethane (mg/kg)	1.8																			
Isopropylbenzene (mg/kg)	190	0.0078	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.600	0.112 U	0.0028 U	
Methyl acetate (mg/kg)	7,800	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U											
Methyl tert-butyl ether (MTBE) (mg/kg)	47	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.000607 U	0.000552 U	0.504 U	0.000576 U	2.77 U	0.00058 U	2.09 U	0.416 U	0.562 U	0.00056 U	
Methylcyclohexane (mg/kg)		0.0038	0.0015 U	0.0012 U	0.0013 U	0.001														

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MP04 5/13/08 (3.5-5ft)	MP04 5/13/08 (8.5-10ft)	MP04 5/13/08 (13.5-15ft)	MP04 5/13/08 (18.5-20ft)	MP04 5/13/08 (25-26.5ft)	MP04 5/12/08 (35-37.5ft)	MP04 5/13/08 (35-37.5ft)	MP04 5/13/08 (38.5-40ft)	MW-1 5/21/07 (5-6.5ft)	MW-1 5/21/07 (35-36.5ft)	MW-2 5/21/07 (10-11.5ft)	MW-2 5/21/07 (40-41.5ft)	MW-3 5/22/07 (5-6.5ft)	MW-3 5/22/07 (25-26.5ft)	MW-4 5/23/07 (15-16.5ft)	MW-4 5/23/07 (30-31.5ft)	MW-5 5/24/07 (10-11.5ft)	MW-5 5/24/07 (20-21.5ft)
tert-Butylbenzene (mg/kg)	780									0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U
Tetrachloroethene (PCE) (mg/kg)	8.1	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00121 U	0.0011 U	0.101 U	0.00115 U	0.553 U	0.00116 U	0.417 U	0.0833 U	0.112 U	0.00112 U
Toluene (mg/kg)	490	0.0048	0.0015 U	0.0012 U	0.00047 J	0.0012 U	0.0012 U		0.0013 U	0.000911 U	0.000827 U	0.101 U	0.000864 U	1.41	0.00087 U	0.417 U	0.0833 U	0.143	0.00084 U
trans-1,2-Dichloroethene (mg/kg)	160	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00152 U	0.00138 U	0.101 U	0.00144 U	0.553 U	0.00145 U	0.417 U	0.0833 U	0.112 U	0.0014 U
trans-1,3-Dichloropropene (mg/kg)		0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.000759 U	0.00069 U	0.101 U	0.00072 U	0.553 U	0.000725 U	0.417 U	0.0833 U	0.112 U	0.0007 U
Trichloroethene (TCE) (mg/kg)	0.41	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00152 U	0.00147	0.101 U	0.00144 U	0.553 U	0.00145 U	0.417 U	0.0833 U	0.112 U	0.0014 U
Trichlorofluoromethane (mg/kg)	2,300	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U	0.101 U	0.00288 U	0.553 U	0.0029 U	0.417 U	0.0833 U	0.112 U	0.0028 U
Vinyl chloride (mg/kg)	0.059	0.001 U	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00152 U	0.00138 U	0.101 U	0.00144 U	0.553 U	0.00145 U	0.417 U	0.0833 U	0.112 U	0.0014 U
m,p-Xylenes (mg/kg)		0.072 J	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U		0.00288 U		0.0029 U				0.0028 U
o-Xylene (mg/kg)	65	0.094 J	0.0015 U	0.0012 U	0.0013 U	0.0012 U	0.0012 U		0.0013 U	0.00304 U	0.00276 U		0.00288 U		0.0029 U				0.0028 U
Xylenes (total) (mg/kg)	58									0.00607 U	0.00552 U	0.353	0.00576 U	8.71	0.0058 U	1.51	2.60	0.337 U	0.0056 U
Polychlorinated Biphenyls (PCBs)																			
Aroclor 1016 (mg/kg)	0.41									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1221 (mg/kg)	0.2									0.0656 U	0.0609 U	0.0561 U	0.0617 U	0.118 U	0.0545 U	0.117 U	0.111 U	0.128 U	0.0577 U
Aroclor 1232 (mg/kg)	0.17									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1242 (mg/kg)	0.23									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1248 (mg/kg)	0.23									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1254 (mg/kg)	0.12									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1260 (mg/kg)	0.24									0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1262 (mg/kg)										0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U
Aroclor 1268 (mg/kg)										0.0328 U	0.0304 U	0.0281 U	0.0308 U	0.0588 U	0.0273 U	0.0587 U	0.0553 U	0.0642 U	0.0289 U

Notes

Concentrations in shaded cells indicate value exceeds Soil PRG.
Where a sample has multiple results for a given analyte (tested for in multiple methods) the highest detected value is shown. Where all results were non-detects, the result with the lowest detection limit is shown.
J = Analyte was positively identified. The reported result is an estimate.
JQ = Approximate value due to quality control problems.
PRG = preliminary remediation goal
QP = Hydrocarbon result partly due to individual peak(s) in quantitation range.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MW-6 5/22/07 (5-6.5ft)	MW-6 5/22/07 (10-11.5ft)	MW-6 5/22/07 (35-36.5ft)	MW-7 5/23/07 (5-6.5ft)	MW-7 5/23/07 (25-26.5ft)	MW-8 5/22/07 (10-11.5ft)	MW-8 5/22/07 (25-26.5ft)	SP01 5/12/08 (3.5-5ft)	SP01 5/12/08 (8.5-10ft)	SP01 5/12/08 (13.5-15ft)	SP01 5/12/08 (18.5-20ft)	SP02 5/12/08 (0-5ft)	SP02 5/12/08 (10-11.5ft)	SP02 5/12/08 (12.5-14ft)	SP02 5/12/08 (18.5-20ft)	SP02 5/12/08 (23.5-25ft)	SP02 5/12/08 (28.5-30ft)
Total Petroleum Hydrocarbons (TPH)																		
Gasoline Range Hydrocarbons (mg/kg)		11.5 U	541	9.16 U	10.6	216	11.8 U	11.9 U	5 U	6 U	5 U	5 U	6 U	6 U	7 U	6 U	6 U	6 U
Diesel Range Hydrocarbons (mg/kg)		11.4 U	3,770 QP	11.2 U	17.1 QP	30,200	11.6 U	336 QP	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Oil Range Hydrocarbons (mg/kg)		28.5 U	390 QP	28.1 U	30.6 U	2,900 U	29.0 U	138 QP	50 U	50 U	50 U	50 U	50 U	50 U	52	50 U	50 U	50 U
Metals																		
Aluminum (mg/kg)	7,700								16,500 J	10,700 J	8,370 J	20,500 J	24,100 J	20,600 J	20,100 J	20,800 J	7,280 J	7,380
Antimony (mg/kg)	0.27	1.64 U	1.58 U	1.82 U	1.84 U	1.81 U	1.77 U	1.69 U										7.3 UJ
Arsenic (mg/kg)	0.68	1.64	1.26	0.841	2.72	1.01	6.72	2.25	2.1	1.1	1.8	1.5	2	3.7	2.7	1.4		1.3
Barium (mg/kg)	330								70.4 J	44.6 J	43.4 J	88.6 J	120 J	103 J	100 J	95.6 J	34.4 J	28.5
Beryllium (mg/kg)	16	0.547 U	0.527 U	0.605 U	0.614 U	0.604 U	0.589 U	0.562 U	0.3 JQ	0.2 JQ	0.2 JQ	0.5 JQ	0.4 JQ	0.5 JQ	0.4 JQ	0.5 JQ	0.2 JQ	0.2 JQ
Cadmium (mg/kg)	0.36	0.547 U	0.527 U	0.605 U	0.614 U	0.604 U	0.966	0.562 U	0.5 JQ	0.4 JQ	0.3 JQ	0.9	0.7	0.9	0.9	1	0.2 JQ	0.2 JQ
Calcium (mg/kg)									3,490	3,740	3,270	6,940	3,180	6,400	6,310	7,290	3,180	3,640
Chromium (Total) (mg/kg)	26	33.1	19.9	24.8	40.1	25.2	36.0	39.4	33	26	29.1	50.9	43.1	51.8	48.7	60.8	20.1	18.9 J
Chromium (VI) (mg/kg)	0.3	1.1 U	1.1 U	1.0 U	1.2 U	1.0 U	1.0 U	1.1 U										
Cobalt (mg/kg)	2.3								9.2	7.8	9.1	15.7	11.1	17.3	15.7	16.9	5.6 JQ	5.4 JQ
Copper (mg/kg)	28	15.5	9.47	16.4	18.2	12.5	68.1	23.3	19.7	14.2	15	41.6	26.3	42.8	40.9	46.4	11.6	9.5
Iron (mg/kg)	5,500								18,400 J	15,100 J	13,800 J	29,600 J	24,800 J	34,300 J	32,800 J	32,400 J	11,700 J	11,100
Lead (mg/kg)	11	2.78	1.36	1.30	5.75	1.67	246	4.75	2.4 J	1.2 J	1.2 U	4.7 J	4.4 J	4.4 J	4.3 J	4.8 J	0.7 JQ	0.6 JQ
Magnesium (mg/kg)									5,120 J	4,580 J	4,430 J	9,510 J	5,720 J	8,930 J	8,710 J	11,400 J	5,050 J	4,600
Manganese (mg/kg)	180								289 J	276 J	341 J	421 J	307 J	627 J	557 J	449 J	192 J	170
Mercury (mg/kg)	1.1	0.113 U	0.104 U	0.111 U	0.111 U	0.0956 U	0.392	0.105 U	0.1 U	0.1 U	0.1 U	0.1 JQ	0.1 U	0.1 U	0.1 JQ	0.1 JQ	0.1 U	0.1 U
Nickel (mg/kg)	38	38.6	28.8	33.3	51.8	43.3	42.1	37.2	40.4 J	34.1 J	42.5 J	58.2 J	41.6 J	57.8 J	56.7 J	56 J	33.5 J	32.3
Potassium (mg/kg)									505 JQ	431 JQ	407 JQ	1,280	404 JQ	1,090	1,080	1,350	370 JQ	401 JQ
Selenium (mg/kg)	0.52	0.547 U	0.527 U	0.605 U	0.614 U	0.604 U	0.589 U	0.562 U	4.1 U	3.9 U	4.1 U	4.5 U	4.4 U	4.6 U	4.5 U	4.5 U	4.1 U	4.2 U
Silver (mg/kg)	4.2	0.547 U	0.527 U	0.605 U	0.614 U	0.604 U	0.589 U	0.562 U	1.2 U	1.1 U	1.2 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.2 U	1.2 U
Sodium (mg/kg)									175 JQ	177 JQ	211 JQ	367 JQ	167 JQ	306 JQ	315 JQ	487 JQ	176 JQ	197 JQ
Thallium (mg/kg)	0.078	0.547 U	0.527 U	0.605 U	0.614 U	0.604 U	0.589 U	0.562 U	3.4	2.8	2.4 JQ	4.5	4.1	5	4.7	5	2.3 JQ	1.8 JQ
Vanadium (mg/kg)	7.8								44.7	35.4	31.5	69.9	62.6	85.3	75.1	86	24	25.4
Zinc (mg/kg)	46	30.5	22.7	31.7	48.1	26.2	291	48.0	34.3 J	29 J	26.2 J	69.2 J	55.9 J	66.4 J	63.9 J	72.3 J	34.7 J	22.3
Organometallics																		
Tributyltin (mg/kg)	2.3	0.00074 U	0.00072 U	0.0016 U	0.0016 U	0.0014 U	0.00072 U	0.00076 U										
Conventional Chemistry Parameters																		
Dry Weight (Percent)		87.0	94.0	87.9	82.3	87.2	84.9	83.9										
Total Organic Carbon (Percent)																		
Total Solids (Percent)		87.0	94.0	87.3	82.3	87.2	84.9	83.9										
Polycyclic Aromatic Hydrocarbons (PAHs)																		
Acenaphthene (mg/kg)	360	0.0230 U	31.2	0.114 U	0.243 U	0.566 U	0.969 U	1.48 U	0.0016 U	0.0011 U	0.0047 J	0.0012 U	0.0089	0.0013 U	0.0013 U	0.0013 U	0.0011 U	0.0012 U
Acenaphthylene (mg/kg)		0.0490	460	0.611	0.243 U	0.566 U	0.969 U	10.4	0.0016 U	0.0011 U	0.0012 UJ	0.0012 U	0.0018	0.0013 U	0.00091 J	0.0013 U	0.0011 U	0.0012 U
Anthracene (mg/kg)	1,800	0.0613	233	0.774	0.243 U	0.566 U	1.47	14.9	0.0016 U	0.0011 U	0.0041 J	0.0012 U	0.0067	0.0013 U	0.026 U	0.0013 U	0.0011 U	0.0012 U
Benzo(g,h,i)perylene (mg/kg)		0.0398	79.0	0.159	1.98	0.604	0.969 U	39.5	0.0022	0.0017	0.0037 J	0.00077 J	0.0026	0.0013	0.002	0.0013	0.0011 U	0.0012 U
Benzo(j)fluoranthene (mg/kg)																		
Dibenzofuran (mg/kg)	7.3	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Fluoranthene (mg/kg)	240	0.123	572	2.99	3.22	3.73 U	0.969 U	79.1	0.0016 U	0.0011 U	0.0053	0.0012 U	0.01	0.0013 U	0.0049	0.0013 U	0.0011 U	0.0012 U
Fluorene (mg/kg)	240	0.0659	404	0.798	0.243 U	4.06	0.969 U	1.48 U	0.0016 U	0.0011 U	0.0034 J	0.0012 U	0.006	0.0013 U	0.0013 U	0.0007 J	0.0011 U	0.0012 U
Phenanthrene (mg/kg)		0.253	1,490	2.99	0.648	12.4	4.21	19.6	0.0016 U	0.0011 U	0.011 J	0.00074 J	0.021 J	0.0013 U	0.0023	0.0013 U	0.0011 U	0.0012 U
Pyrene (mg/kg)	180	0.161	913	1.53	4.33	5.77	1.96	159	0.001 J	0.0011 U	0.0073 J	0.0012 U	0.015 J	0.0013 U	0.0083	0.0013 U	0.0011 U	0.0012 U
1-Methylnaphthalene (mg/kg)	18	0.0230 U	615	1.13	0.243 U	45.2	0.969 U	1.48 U										
2-Methylnaphthalene (mg/kg)	24	0.0245	978	1.79	0.243 U	59.2	0.969 U	1.48 U										
Naphthalene (mg/kg)	3.8	0.00639 U	953	1.49	0.243 U	14.7	0.623 U	0.00535 U	0.0016 J	0.00062 J	0.003 J	0.00047	0.0059	0.0013 U	0.0013 U	0.00075 J	0.0028	0.0017
Benz(a)anthracene (mg/kg)	0.16	0.0475	113	0.265	1.22	1.21	1.47 U	37.6	0.0016 U	0.0011 U	0.0022 J	0.0012 U	0.0044	0.0013 U	0.0035	0.0013 U	0.0011 U	0.0012 U
Benzo(a)pyrene (mg/kg)	0.016	0.0782	116	0.394	1.78	1.85	2.84	47.0	0.0011 J	0.0011 U	0.0027 J	0.0012 U	0.0048	0.0013 U	0.0033	0.0013 U	0.0034	0.0012 U
Benzo(b)fluoranthene (mg/kg)	0.16	0.0368	57.4	0.152	1.22	0.754	1.47 U	27.3	0.0016 UJ	0.0011 UJ	0.0012 U	0.0012 U	0.0024	0.0013 U	0.0015	0.0013 U	0.0011 U	0.0012 U
Benzo(k)fluoranthene (mg/kg)	1.6	0.0536	60.6	0.250	1.49	1.24	1.76	29.0	0.0009 J	0.0011 UJ	0.0016 J	0.0012 U	0.0029	0.0013 U	0.0019	0.0013 U	0.0011 U	0.0012 U
Chrysene (mg/kg)	16	0.0644	146	0.349	2.03	1.58	1.47 U	53.1	0.0011 J	0.0011 U	0.0031 J	0.0012 U	0.0059	0.0013 U	0.0051	0.0013 U	0.0011 U	0.0012 U
Dibenzo(a,h)anthracene (mg/kg)	0.016	0.0245	22.8	0.114 U	0.486	0.566 U	1.47 U	10.3	0.0015 J	0.0011 J	0.0023 J	0.0012 U	0.0013 J	0.00094 J	0.00099 J	0.0008 J	0.0011 U	0.0012 U
Indeno(1,2,3-cd)pyrene (mg/kg)	0.16	0.0368	58.5	0.129	1.52	0.604	1.47 U	28.7	0.0019	0.0013	0.003 J	0.0012 U	0.0022	0.001 J	0.0016	0.00087 J	0.0011 U	0.0012 U
Total cPAHs TEQ (ND = 0) (mg/kg)	0.016	0.0988	149	0.477	2.39	2.25	3.02	60.8	0.00154	0.00024	0.00364 J	ND	0.00618	0.000194 J	0.0043	0.000167 J	0.0034	ND
Total cPAHs TEQ (ND = 1/2 RDL) (mg/kg)	0.016	0.0988	149	0.483	2.39	2.27	3.32	60.8	0.0017	0.000961	0.0037 J	ND	0.00618	0.00105 J	0.0043	0.00102 J	0.00368	ND

Table F-2

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MW-6 5/22/07 (5-6.5ft)	MW-6 5/22/07 (10-11.5ft)	MW-6 5/22/07 (35-36.5ft)	MW-7 5/23/07 (5-6.5ft)	MW-7 5/23/07 (25-26.5ft)	MW-8 5/22/07 (10-11.5ft)	MW-8 5/22/07 (25-26.5ft)	SP01 5/12/08 (3.5-5ft)	SP01 5/12/08 (8.5-10ft)	SP01 5/12/08 (13.5-15ft)	SP01 5/12/08 (18.5-20ft)	SP02 5/12/08 (0-5ft)	SP02 5/12/08 (10-11.5ft)	SP02 5/12/08 (12.5-14ft)	SP02 5/12/08 (18.5-20ft)	SP02 5/12/08 (23.5-25ft)	SP02 5/12/08 (28.5-30ft)
Other (Non-PAH) Semivolatiles																		
1,1'-Biphenyl (mg/kg)	4.7								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
1,2,4,5-Tetrachlorobenzene (mg/kg)	2.3								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
1,2-Dichlorobenzene (mg/kg)	180																	
1,3-Dichlorobenzene (mg/kg)									0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,4-Dichlorobenzene (mg/kg)	2.6																	
1,4-Dioxane (mg/kg)	5.3								0.21 U	0.11 U	0.12 U	0.13 U	0.14 U	0.18 U	0.13 U	0.11 U	0.12 U	0.19 U
2,3,4,6-Tetrachlorophenol (mg/kg)	190								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4,5-Trichlorophenol (mg/kg)	630	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4,6-Trichlorophenol (mg/kg)	6.3	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4-Dichlorophenol (mg/kg)	19	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4-Dimethylphenol (mg/kg)	130	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4-Dinitrophenol (mg/kg)	13	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.17 UJ	0.12 UJ	0.12 UJ	0.12 UJ	0.13 UJ	0.13 UJ	0.13 U	0.13 U	0.12 U	0.12 U
2-Chloronaphthalene (mg/kg)	480	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2-Chlorophenol (mg/kg)	39	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2-Methylphenol (mg/kg)	320	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U										
2-Nitroaniline (mg/kg)	63	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.067 U	0.047 U	0.048 U	0.049 U	0.052 U	0.053 U	0.052 U	0.052 U	0.047 U	0.049 U
2-Nitrophenol (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
3 & 4 Methylphenol (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U										
3,3'-Dichlorobenzidine (mg/kg)	1.2	11.5 U	2,630 U	5.69 U	6.08 U	56.6 U	14.7 U	148 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
3-Nitroaniline (mg/kg)		1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.067 U	0.047 U	0.048 U	0.049 U	0.052 U	0.053 U	0.052 U	0.052 U	0.047 U	0.049 U
4,6-Dinitro-2-methylphenol (mg/kg)	0.51	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.067 U	0.047 U	0.048 U	0.049 U	0.052 U	0.053 U	0.052 U	0.052 U	0.047 U	0.049 U
4-Bromophenyl phenyl ether (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
4-Chloro-3-methylphenol (mg/kg)	630	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
4-Chloroaniline (mg/kg)	2.7	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
4-Chlorophenyl phenyl ether (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
4-Methylphenol (mg/kg)	630								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
4-Nitroaniline (mg/kg)	25	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.067 U	0.047 U	0.048 U	0.049 U	0.052 U	0.053 U	0.052 U	0.052 U	0.047 U	0.049 U
4-Nitrophenol (mg/kg)		1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.067 U	0.047 U	0.048 U	0.049 U	0.052 U	0.053 U	0.052 U	0.052 U	0.047 U	0.049 U
Acenaphthene (mg/kg)	360																	
Acetophenone (mg/kg)									0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Aniline (mg/kg)	44	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U										
Atrazine (mg/kg)									0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Benzaldehyde (mg/kg)									0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Benzdine (mg/kg)	0.00053								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Benzoic acid (mg/kg)	25,000	2.30 U	527 U	1.14 U	1.22 U	11.3 U	2.93 U	29.7 U										
Benzyl alcohol (mg/kg)	630	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U										
Benzyl butyl phthalate (mg/kg)	290	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Bis(2-chloro-1-methylethyl) ether (mg/kg)	310	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Bis(2-chloroethoxy)methane (mg/kg)	19	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Bis(2-chloroethyl) ether (mg/kg)	0.23	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Bis(2-ethylhexyl) phthalate (mg/kg)	39	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.16	0.096	0.12	0.18	0.16	0.17	0.24	0.11	0.2	0.24
Caprolactam (mg/kg)									0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Carbazole (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Dibenzofuran (mg/kg)	7.3																	
Diethyl phthalate (mg/kg)	5,100	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Dimethyl phthalate (mg/kg)		0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Di-n-butyl phthalate (mg/kg)	630	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Di-n-octyl phthalate (mg/kg)	63	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Hexachlorobenzene (mg/kg)	0.21	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Hexachlorobutadiene (mg/kg)	1.2				0.401 U													
Hexachlorocyclopentadiene (mg/kg)	0.18	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.082 UJ	0.058 UJ	0.06 UJ	0.061 UJ	0.065 UJ	0.066 UJ	0.065 U	0.064 U	0.059 U	0.061 U
Hexachloroethane (mg/kg)	1.8	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.0042 U	0.0022 U	0.0024 U	0.0026 U	0.0027 U	0.0036 U	0.0026 U	0.0022 U	0.0024 U	0.0038 U
Isophorone (mg/kg)	570	0.759 U	174 U	0.375 U	0.401 U	6.30	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Nitrobenzene (mg/kg)	5.1	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U										
N-Nitrosodimethylamine (mg/kg)	0.002								0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
N-Nitroso-di-n-propylamine (mg/kg)	0.078	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
N-Nitrosodiphenylamine (mg/kg)	110	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
Pentachlorophenol (mg/kg)	1	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U	0.0033 U	0.0023 U	0.0024 U	0.0024 U	0.0026 UJ	0.0026 U	0.0026 U	0.0025 U	0.0023 U	0.0024 U
Phenol (mg/kg)	1,900	0.759 U	174 U	0.375 U	0.401 U	3.73 U	0.969 U	9.80 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
2,4-Dinitrotoluene (mg/kg)	1.7	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U										
2,6-Dinitrotoluene (mg/kg)	0.36	1.15 U	263 U	0.569 U	0.608 U	5.66 U	1.47 U	14.8 U										
2-Methylnaphthalene (mg/kg)	24								0.0016 U	0.0011 U	0.0031 J	0.0012 U	0.0062	0.0013 U	0.0013 U	0.0013 U	0.0011 U	0.0012 U

Table F-2

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MW-6 5/22/07 (5-6.5ft)	MW-6 5/22/07 (10-11.5ft)	MW-6 5/22/07 (35-36.5ft)	MW-7 5/23/07 (5-6.5ft)	MW-7 5/23/07 (25-26.5ft)	MW-8 5/22/07 (10-11.5ft)	MW-8 5/22/07 (25-26.5ft)	SP01 5/12/08 (3.5-5ft)	SP01 5/12/08 (8.5-10ft)	SP01 5/12/08 (13.5-15ft)	SP01 5/12/08 (18.5-20ft)	SP02 5/12/08 (0-5ft)	SP02 5/12/08 (10-11.5ft)	SP02 5/12/08 (12.5-14ft)	SP02 5/12/08 (18.5-20ft)	SP02 5/12/08 (23.5-25ft)	SP02 5/12/08 (28.5-30ft)
Volatile Organic Compounds (VOC)																		
1,1,1,2-Tetrachloroethane (mg/kg)	2	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1,1-Trichloroethane (mg/kg)	810	0.0016 U	3.60 U	0.00197 U	0.102 U	0.117 U	0.125 U	0.00134 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1,2 - Trichlorotrifluoroethane (mg/kg)	4,000								0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1,2,2-Tetrachloroethane (mg/kg)	0.6	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1,2-Trichloroethane (mg/kg)	0.15	0.000798 U	3.60 U	0.000985 U	0.102 U	0.117 U	0.125 U	0.000669 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1-Dichloroethane (mg/kg)	3.6	0.00128 U	3.60 U	0.00158 U	0.102 U	0.117 U	0.125 U	0.00107 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1-Dichloroethene (mg/kg)	23	0.00192 U	3.60 U	0.00236 U	0.102 U	0.117 U	0.125 U	0.00161 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,1-Dichloropropene (mg/kg)		0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
1,2,3-Trichlorobenzene (mg/kg)	6.3	0.00639 U	18.0 U	0.00788 U	0.511 U	0.587 U	0.623 U	0.00535 U	0.00014 J	0.0054 U	0.0061 U	0.0065 U	0.0068 U	0.009 U	0.0064 U	0.00013 J	0.006 U	0.0094 U
1,2,3-Trichloropropane (mg/kg)	0.0051	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,2,4-Trichlorobenzene (mg/kg)	5.8	0.00639 U	18.0 U	0.00788 U	0.511 U	0.587 U	0.623 U	0.00535 U	0.00023 J	0.0054 U	0.0061 U	0.0065 U	0.0068 U	0.009 U	0.0064 U	0.0063 U	0.006 U	0.0094 U
1,2,4-Trimethylbenzene (mg/kg)	5.8	0.00319 U	13.2	0.00394 U	0.103	6.85	0.125 U	0.00268 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
1,2-Dibromo-3-chloropropane (mg/kg)	0.0053	0.00639 U	18.0 U	0.00788 U	0.511 U	0.587 U	0.623 U	0.00535 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,2-Dibromoethane (EDB) (mg/kg)	0.036	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,2-Dichlorobenzene (mg/kg)	180	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,2-Dichloroethane (EDC) (mg/kg)	0.46	0.000798 U	3.60 U	0.000985 U	0.102 U	0.117 U	0.125 U	0.000669 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,2-Dichloropropane (mg/kg)	1	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,3,5-Trimethylbenzene (mg/kg)	78	0.00319 U	3.67	0.00394 U	0.102 U	0.927	0.125 U	0.00268 U	0.033 U	0.024 U	0.024 U	0.025 U	0.026 U	0.026 U	0.026 U	0.026 U	0.023 U	0.024 U
1,3-Dichlorobenzene (mg/kg)		0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
1,3-Dichloropropane (mg/kg)	160	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
1,4-Dichlorobenzene (mg/kg)	2.6	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
1,4-Difluorobenzene (mg/kg)																		
2,2-Dichloropropane (mg/kg)		0.00639 U	3.60 U	0.00788 U	0.102 U	0.117 U	0.125 U	0.00535 U										
2-Butanone (mg/kg)	2,700	0.00958 U	36.0 U	0.0118 U	1.02 U	1.17 U	1.25 U	0.00803 U	0.011 U	0.0054 U	0.0061 U	0.0065 U	0.0068 U	0.009 U	0.0064 U	0.0056 U	0.006 U	0.0094 U
2-Chlorotoluene (mg/kg)	160	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
2-Hexanone (mg/kg)	20	0.0128 U	36.0 U	0.0158 U	1.02 U	1.17 U	1.25 U	0.0107 U	0.011 UJ	0.0054 UJ	0.0061 UJ	0.0065 UJ	0.0068 UJ	0.009 UJ	0.0064 U	0.0063 U	0.006 U	0.0094 U
4-Chlorotoluene (mg/kg)	160	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
4-Methyl-2-pentanone (mg/kg)	3,300	0.0128 U	36.0 U	0.0158 U	1.02 U	1.17 U	1.25 U	0.0107 U	0.011 U	0.0054 U	0.0061 U	0.0065 U	0.0068 U	0.009 U	0.0064 U	0.0056 U	0.006 U	0.0094 U
Acetone (mg/kg)	6,100	0.0192 U	36.0 U	0.0236 U	1.02 U	1.17 U	1.25 U	0.0161 U	0.055	0.031	0.04	0.0065 U	0.036	0.025	0.0094	0.027	0.05	0.028
Benzene (mg/kg)	1.2	0.000958 U	0.719 U	0.00722	0.102 U	0.117 U	0.0249 U	0.000803 U	0.0022	0.002	0.0012 J	0.00085 J	0.0014 U	0.0014 J	0.0012 J	0.00088 J	0.00069 J	0.0019 U
Bromobenzene (mg/kg)	29	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
Bromochloromethane (mg/kg)	15	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Bromodichloromethane (mg/kg)	0.29	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Bromoform (mg/kg)	19	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Bromomethane (mg/kg)	0.68	0.00639 U	3.60 U	0.00788 U	0.102 U	0.117 U	0.125 U	0.00535 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Carbon disulfide (mg/kg)	77	0.00192 U	3.60 U	0.00236 U	0.102 U	0.117 U	0.125 U	0.00161 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Carbon tetrachloride (mg/kg)	0.65	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Chlorobenzene (mg/kg)	28	0.00128 U	3.60 U	0.00158 U	0.102 U	0.117 U	0.125 U	0.00107 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Chlorobenzene-d5 (mg/kg)																		
Chloroethane (mg/kg)	1,400	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Chloroform (mg/kg)	0.32	0.0016 U	3.60 U	0.00197 U	0.102 U	0.117 U	0.125 U	0.00134 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Chloromethane (mg/kg)	11	0.00639 U	18.0 U	0.00788 U	0.511 U	0.587 U	0.623 U	0.00535 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
cis-1,2-Dichloroethene (DCE) (mg/kg)	16	0.00192 U	3.60 U	0.00236 U	0.102 U	0.117 U	0.125 U	0.00161 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
cis-1,3-Dichloropropene (mg/kg)		0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Cyclohexane (mg/kg)	650								0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Dibromochloromethane (mg/kg)	8.3	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Dibromomethane (mg/kg)	2.4	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
Dichlorodifluoromethane (mg/kg)	8.7	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Ethylbenzene (mg/kg)	5.8	0.00255 U	3.60 U	0.00475	0.102 U	0.250	0.125 U	0.00214 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Hexachlorobutadiene (mg/kg)	1.2	0.00639 U	18.0 U	0.00788 U		0.587 U	0.623 U	0.00535 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Hexachloroethane (mg/kg)	1.8																	
Isopropylbenzene (mg/kg)	190	0.00319 U	3.60 U	0.00394 U	0.102 U	0.418	0.125 U	0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Methyl acetate (mg/kg)	7,800								0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Methyl tert-butyl ether (MTBE) (mg/kg)	47	0.000639 U	18.0 U	0.000788 U	0.511 U	0.587 U	0.623 U	0.000535 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Methylcyclohexane (mg/kg)									0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Methylene chloride (mg/kg)	35	0.00223 U	36.0 U	0.00276 U	1.02 U	1.17 U	1.25 U	0.00187 U	0.0021 U	0.0011 U	0.0013 U	0.001 J	0.0014 U	0.0018 U	0.0011 J	0.00086 J	0.00096 J	0.0014 J
n-Butylbenzene (mg/kg)	390	0.00319 U	3.60 U	0.00394 U	0.102 U	1.78	0.12											

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	MW-6 5/22/07 (5-6.5ft)	MW-6 5/22/07 (10-11.5ft)	MW-6 5/22/07 (35-36.5ft)	MW-7 5/23/07 (5-6.5ft)	MW-7 5/23/07 (25-26.5ft)	MW-8 5/22/07 (10-11.5ft)	MW-8 5/22/07 (25-26.5ft)	SP01 5/12/08 (3.5-5ft)	SP01 5/12/08 (8.5-10ft)	SP01 5/12/08 (13.5-15ft)	SP01 5/12/08 (18.5-20ft)	SP02 5/12/08 (0-5ft)	SP02 5/12/08 (10-11.5ft)	SP02 5/12/08 (12.5-14ft)	SP02 5/12/08 (18.5-20ft)	SP02 5/12/08 (23.5-25ft)	SP02 5/12/08 (28.5-30ft)
tert-Butylbenzene (mg/kg)	780	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U										
Tetrachloroethene (PCE) (mg/kg)	8.1	0.00128 U	3.60 U	0.00158 U	0.102 U	0.117 U	0.125 U	0.00107 U	0.00059 J	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Toluene (mg/kg)	490	0.000958 U	5.00	0.00118 U	0.198	0.117 U	0.125 U	0.000803 U	0.00084 J	0.00057 J	0.00063 J	0.0012 J	0.0016	0.0018 U	0.001 U	0.0006 J	0.0012 U	0.0019 U
trans-1,2-Dichloroethene (mg/kg)	160	0.0016 U	3.60 U	0.00197 U	0.102 U	0.117 U	0.125 U	0.00134 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
trans-1,3-Dichloropropene (mg/kg)		0.000798 U	3.60 U	0.000985 U	0.102 U	0.117 U	0.125 U	0.000669 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Trichloroethene (TCE) (mg/kg)	0.41	0.0016 U	3.60 U	0.00197 U	0.102 U	0.117 U	0.125 U	0.00134 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Trichlorofluoromethane (mg/kg)	2,300	0.00319 U	3.60 U	0.00394 U	0.102 U	0.117 U	0.125 U	0.00268 U	0.0019 J	0.0006 J	0.00094 J	0.0018	0.0032	0.0013 J	0.0015	0.00088 J	0.00084 J	0.0019 U
Vinyl chloride (mg/kg)	0.059	0.0016 U	3.60 U	0.00197 U	0.102 U	0.117 U	0.125 U	0.00134 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
m,p-Xylenes (mg/kg)		0.00319 U		0.00394 U				0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
o-Xylene (mg/kg)	65	0.00319 U		0.00394 U				0.00268 U	0.0021 U	0.0011 U	0.0012 U	0.0013 U	0.0014 U	0.0018 U	0.0013 U	0.0011 U	0.0012 U	0.0019 U
Xylenes (total) (mg/kg)	58	0.00639 U	16.7	0.00788 U	0.363	0.421	0.374 U	0.00535 U										
Polychlorinated Biphenyls (PCBs)																		
Aroclor 1016 (mg/kg)	0.41	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1221 (mg/kg)	0.2	0.0577 U	0.102 U	0.111 U	0.0602 U	0.0577 U	0.0581 U	0.0602 U										
Aroclor 1232 (mg/kg)	0.17	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1242 (mg/kg)	0.23	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1248 (mg/kg)	0.23	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1254 (mg/kg)	0.12	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1260 (mg/kg)	0.24	0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1262 (mg/kg)		0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										
Aroclor 1268 (mg/kg)		0.0288 U	0.0508 U	0.0554 U	0.0301 U	0.0289 U	0.0291 U	0.0301 U										

Notes

Concentrations in shaded cells indicate value exceeds Soil PRG.
Where a sample has multiple results for a given analyte (tested for in multiple methods) the highest detected value is shown. Where all results were non-detects, the result with the lowest detection limit is shown.
J = Analyte was positively identified. The reported result is an estimate.
JQ = Approximate value due to quality control problems.
PRG = preliminary remediation goal
QP = Hydrocarbon result partly due to individual peak(s) in quantitation range.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	SP03 5/12/08 (4.3-5ft)	SP03 5/12/08 (5-6.5ft)	SP03 5/12/08 (13.5-15ft)	SP03 5/12/08 (18.5-20ft)	SP03 5/12/08 (23.5-25ft)	SP03 5/12/08 (28.5-30ft)	SP03 5/12/08 (33.5-35ft)	SP03 5/12/08 (38.5-40ft)	SP03 5/12/08 (43.5-45ft)
Total Petroleum Hydrocarbons (TPH)										
Gasoline Range Hydrocarbons (mg/kg)		200 J	30,000 U		9	6 U	11 U	8 U	6 U	
Diesel Range Hydrocarbons (mg/kg)		100 U	36,000 J		25 U	25 U	25 U	25 U	25 U	
Oil Range Hydrocarbons (mg/kg)		4,700 J	29,000 J		50 U	50 U	50 U	50 U	50 U	
Metals										
Aluminum (mg/kg)	7,700	14,900	5,780	14,700	18,200	19,600	22,000	22,500	19,600	8,430
Antimony (mg/kg)	0.27	7.2 UJ	1.2 J	6 UJ	7.5 UJ	7.6 UJ	7.7 UJ	7.9 UJ	7.5 UJ	7.1 UJ
Arsenic (mg/kg)	0.68	4.2	7.8		3.9	1.2	2.5	4.6	2.2	0.6
Barium (mg/kg)	330	71.3	74.1	63.9	94	101	110	113	93.9	31.3
Beryllium (mg/kg)	16	0.3 JQ	0.1 JQ	0.3 JQ	0.4 JQ	0.4 JQ	0.5 JQ	0.5 JQ	0.4 JQ	0.2 JQ
Cadmium (mg/kg)	0.36	1.2	1.6	0.6	0.9	0.9	1.1	1.2	0.9	0.3 JQ
Calcium (mg/kg)		7,440	21,300	4,410	7,080	7,250	7,940	7,900	7,230	3,740
Chromium (Total) (mg/kg)	26	28.1 J	59.9 J	32 J	48.3 J	46.2 J	53.3 J	54.7 J	46.7 J	21.2 J
Chromium (VI) (mg/kg)	0.3									
Cobalt (mg/kg)	2.3	10.3	3.3 JQ	11.9	14.1	15.5	17.3	18.1	15.6	6.4
Copper (mg/kg)	28	45.7	62.7	24.6	41.2	43.7	52.1	54	44.5	12.9
Iron (mg/kg)	5,500	24,300	47,800	21,000	33,000	32,400	36,500	37,200	32,400	13,600
Lead (mg/kg)	11	31.2	128	2.8	4.5	4.7	5.2	5.4	4.3	0.8 JQ
Magnesium (mg/kg)		5,130	1,380	5,520	9,970	12,200	14,300	14,900	12,500	4,820
Manganese (mg/kg)	180	388	215	339	824	520	662	678	515	235
Mercury (mg/kg)	1.1	0.1 JQ	0.1 JQ	0.1 U	0.1 JQ	0.1 JQ	0.1 JQ	0.1 JQ	0.1 JQ	0.1 U
Nickel (mg/kg)	38	60.9	28.4	40.2	52.9	56.5	62.2	65.3	56.2	31.7
Potassium (mg/kg)		563 JQ	233 JQ	587	1,240	1,570	1,900	2,000	1,690	413 JQ
Selenium (mg/kg)	0.52	4.2 U	5.7 U	3.5 U	4.4 U	4.5 U	4.5 U	4.6 U	4.4 U	4.2 U
Silver (mg/kg)	4.2	1.2 U	1.6 U	1 U	1.3 U	1.3 U	1.3 U	1.3 U	1.2 U	1.2 U
Sodium (mg/kg)		263 JQ	377 JQ	171 JQ	468 JQ	527 JQ	565 JQ	543 JQ	544 JQ	209 JQ
Thallium (mg/kg)	0.078	3	4.1 U	3.9	5.1	4.6	5.5	5.7	5	2.2 JQ
Vanadium (mg/kg)	7.8	54.1	30.2	47.2	73.4	70.4	77.8	80.1	71.3	29.9
Zinc (mg/kg)	46	114	376	44.3	62.7	65.7	76.7	79	67.4	33
Organometallics										
Tributyltin (mg/kg)	2.3									
Conventional Chemistry Parameters										
Dry Weight (Percent)										
Total Organic Carbon (Percent)										
Total Solids (Percent)										
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene (mg/kg)	360	0.46	0.053	0.012	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.049
Acenaphthylene (mg/kg)		1.3	1.4	0.13	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0012 U
Anthracene (mg/kg)	1,800	0.32	0.7	0.018 J	0.026 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.017 J
Benzo(g,h,i)perylene (mg/kg)		5.7	25	0.021 J	0.0023	0.0013 U	0.0023	0.0025	0.0023	0.0012 U
Benzo(j)fluoranthene (mg/kg)										
Dibenzofuran (mg/kg)	7.3	0.37	0.063	0.017 J	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Fluoranthene (mg/kg)	240	37	22	0.071	0.0071	0.003	0.0013 U	0.0086	0.0059	0.036
Fluorene (mg/kg)	240	1.1	6.9	0.072	0.004	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.023 J
Phenanthrene (mg/kg)		5.5	29	0.17	0.012	0.0024	0.0013 U	0.0041	0.0022	0.085
Pyrene (mg/kg)	180	41	27	0.089	0.0097	0.0043	0.0095	0.011	0.0074	0.041
1-Methylnaphthalene (mg/kg)	18									
2-Methylnaphthalene (mg/kg)	24									
Naphthalene (mg/kg)	3.8	8.7	620	1.3	1.3	0.0079	0.01	0.019 J	0.01	0.28
Benz(a)anthracene (mg/kg)	0.16	11	12	0.026	0.003	0.0013 U	0.0026	0.0032	0.0023	0.0012 U
Benzo(a)pyrene (mg/kg)	0.016	15	30	0.025	0.0035	0.015	0.013	0.01	0.018	0.0012 U
Benzo(b)fluoranthene (mg/kg)	0.16	6.9	27	0.016 J	0.0025	0.0013 U	0.0023	0.0027	0.0025	0.0012 U
Benzo(k)fluoranthene (mg/kg)	1.6	10	7.2	0.016	0.0028	0.0013 U	0.0027	0.0029	0.0024	0.0012 U
Chrysene (mg/kg)	16	20	36	0.037	0.0048	0.0023	0.0043	0.0049	0.0038	0.0012 U
Dibenzo(a,h)anthracene (mg/kg)	0.016	1.4	13	0.0028	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0012 U
Indeno(1,2,3-cd)pyrene (mg/kg)	0.16	5.1	28	0.015 J	0.0016	0.0013 U	0.0016	0.0018	0.0016	0.0012 U
Total cPAHs TEQ (ND = 0) (mg/kg)	0.016	18.6	39.1	0.033	0.00454	0.015	0.014	0.0111	0.0189	ND
Total cPAHs TEQ (ND = 1/2 RDL) (mg/kg)	0.016	18.6	39.1	0.033	0.0046	0.0153	0.014	0.0112	0.019	ND

Table F-2

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	SP03 5/12/08 (4.3-5ft)	SP03 5/12/08 (5-6.5ft)	SP03 5/12/08 (13.5-15ft)	SP03 5/12/08 (18.5-20ft)	SP03 5/12/08 (23.5-25ft)	SP03 5/12/08 (28.5-30ft)	SP03 5/12/08 (33.5-35ft)	SP03 5/12/08 (38.5-40ft)	SP03 5/12/08 (43.5-45ft)
Other (Non-PAH) Semivolatiles										
1,1'-Biphenyl (mg/kg)	4.7	0.98	0.065	0.039	0.014 J	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
1,2,4,5-Tetrachlorobenzene (mg/kg)	2.3	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
1,2-Dichlorobenzene (mg/kg)	180									
1,3-Dichlorobenzene (mg/kg)		0.025 U	0.031 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,4-Dichlorobenzene (mg/kg)	2.6									
1,4-Dioxane (mg/kg)	5.3	12 U	140 U	0.13 U	0.12 U	0.16 U	0.18 U	0.15 U	0.19 U	0.25 U
2,3,4,6-Tetrachlorophenol (mg/kg)	190	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2,4,5-Trichlorophenol (mg/kg)	630	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2,4,6-Trichlorophenol (mg/kg)	6.3	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2,4-Dichlorophenol (mg/kg)	19	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2,4-Dimethylphenol (mg/kg)	130	0.025 U	0.031 U	0.031 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2,4-Dinitrophenol (mg/kg)	13	0.12 U	0.16 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
2-Chloronaphthalene (mg/kg)	480	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2-Chlorophenol (mg/kg)	39	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
2-Methylphenol (mg/kg)	320									
2-Nitroaniline (mg/kg)	63	0.05 U	0.063 U	0.052 U	0.052 U	0.052 U	0.052 U	0.054 U	0.052 U	0.05 U
2-Nitrophenol (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
3 & 4 Methylphenol (mg/kg)										
3,3'-Dichlorobenzidine (mg/kg)	1.2	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
3-Nitroaniline (mg/kg)		0.05 U	0.063 U	0.052 U	0.052 U	0.052 U	0.052 U	0.054 U	0.052 U	0.05 U
4,6-Dinitro-2-methylphenol (mg/kg)	0.51	0.05 U	0.063 U	0.052 U	0.052 U	0.052 U	0.052 U	0.054 U	0.052 U	0.05 U
4-Bromophenyl phenyl ether (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
4-Chloro-3-methylphenol (mg/kg)	630	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
4-Chloroaniline (mg/kg)	2.7	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
4-Chlorophenyl phenyl ether (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
4-Methylphenol (mg/kg)	630	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
4-Nitroaniline (mg/kg)	25	0.05 U	0.063 U	0.052 U	0.052 U	0.052 U	0.052 U	0.054 U	0.052 U	0.05 U
4-Nitrophenol (mg/kg)		0.05 U	0.063 U	0.052 U	0.052 U	0.052 U	0.052 U	0.054 U	0.052 U	0.05 U
Acenaphthene (mg/kg)	360									
Acetophenone (mg/kg)		1.5	0.03 J	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Aniline (mg/kg)	44									
Atrazine (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Benzaldehyde (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Benzidine (mg/kg)	0.00053	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Benzoic acid (mg/kg)	25,000									
Benzyl alcohol (mg/kg)	630									
Benzyl butyl phthalate (mg/kg)	290	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Bis(2-chloro-1-methylethyl) ether (mg/kg)	310	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Bis(2-chloroethoxy)methane (mg/kg)	19	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Bis(2-chloroethyl) ether (mg/kg)	0.23	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Bis(2-ethylhexyl) phthalate (mg/kg)	39	0.025 U	0.031 U	0.1	0.11	0.14	0.15	0.1	0.12	0.1
Caprolactam (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Carbazole (mg/kg)		0.49	0.12	0.026	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.019 J
Dibenzofuran (mg/kg)	7.3									
Diethyl phthalate (mg/kg)	5,100	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Dimethyl phthalate (mg/kg)		0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Di-n-butyl phthalate (mg/kg)	630	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Di-n-octyl phthalate (mg/kg)	63	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Hexachlorobenzene (mg/kg)	0.21	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Hexachlorobutadiene (mg/kg)	1.2									
Hexachlorocyclopentadiene (mg/kg)	0.18	0.062 U	0.078 U	0.065 U	0.064 U	0.064 U	0.065 U	0.067 U	0.065 U	0.063 U
Hexachloroethane (mg/kg)	1.8	0.025 U	0.031 U	0.0026 U	0.0025 U	0.0032 U	0.0037 U	0.0029 U	0.0038 U	0.0049 U
Isophorone (mg/kg)	570	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Nitrobenzene (mg/kg)	5.1									
N-Nitrosodimethylamine (mg/kg)	0.002	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
N-Nitroso-di-n-propylamine (mg/kg)	0.078	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
N-Nitrosodiphenylamine (mg/kg)	110	0.025 U	0.031 U	0.026 U	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
Pentachlorophenol (mg/kg)	1	0.025 U	0.031 U	0.0026 U	0.0025 U	0.0025 U	0.0026 U	0.0026 U	0.0026 U	0.0025 U
Phenol (mg/kg)	1,900	0.025 U	0.031 U	0.023 J	0.039	0.081	0.026 U	0.062	0.1	0.077
2,4-Dinitrotoluene (mg/kg)	1.7									
2,6-Dinitrotoluene (mg/kg)	0.36									
2-Methylnaphthalene (mg/kg)	24	6.6	63	0.38	0.17	0.0022	0.0034	0.0059	0.0028	0.079

Table F-2

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	SP03 5/12/08 (4.3-5ft)	SP03 5/12/08 (5-6.5ft)	SP03 5/12/08 (13.5-15ft)	SP03 5/12/08 (18.5-20ft)	SP03 5/12/08 (23.5-25ft)	SP03 5/12/08 (28.5-30ft)	SP03 5/12/08 (33.5-35ft)	SP03 5/12/08 (38.5-40ft)	SP03 5/12/08 (43.5-45ft)
Volatile Organic Compounds (VOC)										
1,1,1,2-Tetrachloroethane (mg/kg)	2	1.2 U	14 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1,1-Trichloroethane (mg/kg)	810	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1,2 - Trichlorotrifluoroethane (mg/kg)	4,000	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1,2,2-Tetrachloroethane (mg/kg)	0.6	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1,2-Trichloroethane (mg/kg)	0.15	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1-Dichloroethane (mg/kg)	3.6	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1-Dichloroethene (mg/kg)	23	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,1-Dichloropropene (mg/kg)										
1,2,3-Trichlorobenzene (mg/kg)	6.3	0.58 U	7 U	0.0064 U	0.0062 U	0.00017 J	0.00017 J	0.0073 U	0.00017 J	0.012 U
1,2,3-Trichloropropane (mg/kg)	0.0051	1.2 U	14 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,2,4-Trichlorobenzene (mg/kg)	5.8	0.58 U	7 U	0.0064 U	0.0062 U	0.0079 U	0.0092 U	0.0073 U	0.0094 U	0.012 U
1,2,4-Trimethylbenzene (mg/kg)	5.8	2.5	0.031 U	0.014 J	0.026 U	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
1,2-Dibromo-3-chloropropane (mg/kg)	0.0053	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,2-Dibromoethane (EDB) (mg/kg)	0.036	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,2-Dichlorobenzene (mg/kg)	180	0.025 U	0.031 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,2-Dichloroethane (EDC) (mg/kg)	0.46	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,2-Dichloropropane (mg/kg)	1	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
1,3,5-Trimethylbenzene (mg/kg)	78	5.5	0.031 U	0.041	0.026	0.026 U	0.026 U	0.027 U	0.026 U	0.025 U
1,3-Dichlorobenzene (mg/kg)										
1,3-Dichloropropane (mg/kg)	160									
1,4-Dichlorobenzene (mg/kg)	2.6	0.025 U	0.031 U	0.0013 U	0.0012 U	0.0016 U	0.00037 J	0.0015 U	0.0019 U	0.0025 U
1,4-Difluorobenzene (mg/kg)										
2,2-Dichloropropane (mg/kg)										
2-Butanone (mg/kg)	2,700	1.2 U	2.4 J	0.0064 U	0.0062 U	0.015	0.0092 U	0.0073 U	0.0094 U	0.012 U
2-Chlorotoluene (mg/kg)	160									
2-Hexanone (mg/kg)	20	1.2 U	14 U	0.0064 U	0.0062 U	0.0079 U	0.0092 U	0.0073 U	0.0094 U	0.012 U
4-Chlorotoluene (mg/kg)	160									
4-Methyl-2-pentanone (mg/kg)	3,300	1.2 U	14 U	0.0064 U	0.0062 U	0.0079 U	0.0092 U	0.0073 U	0.0094 U	0.012 U
Acetone (mg/kg)	6,100	1.2 U	14 U	0.047	0.024	0.064	0.047	0.033	0.056	0.012 U
Benzene (mg/kg)	1.2	4.7	12	0.0016	0.0064	0.23	0.044	0.38	0.17	0.01
Bromobenzene (mg/kg)	29									
Bromochloromethane (mg/kg)	15	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Bromodichloromethane (mg/kg)	0.29	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Bromoform (mg/kg)	19	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Bromomethane (mg/kg)	0.68	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Carbon disulfide (mg/kg)	77	0.58 U	7 U	0.0013 U	0.0012 U	0.0059	0.0043	0.0075	0.0056	0.0025 U
Carbon tetrachloride (mg/kg)	0.65	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Chlorobenzene (mg/kg)	28	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Chlorobenzene-d5 (mg/kg)										
Chloroethane (mg/kg)	1,400	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Chloroform (mg/kg)	0.32	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.00048 J	0.0015 U	0.00056 J	0.044
Chloromethane (mg/kg)	11	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
cis-1,2-Dichloroethene (DCE) (mg/kg)	16	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
cis-1,3-Dichloropropene (mg/kg)		0.58 U	0.93 J	0.0013 U	0.0012 U	0.0016 U	0.00063 J	0.0015 U	0.00064 J	0.0025 U
Cyclohexane (mg/kg)	650	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Dibromochloromethane (mg/kg)	8.3	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Dibromomethane (mg/kg)	2.4									
Dichlorodifluoromethane (mg/kg)	8.7	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Ethylbenzene (mg/kg)	5.8	3.6	24	0.01	0.0061	0.0016 U	0.00073 J	0.0015 U	0.0011 J	0.0018 J
Hexachlorobutadiene (mg/kg)	1.2	0.025 U	0.031 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Hexachloroethane (mg/kg)	1.8									
Isopropylbenzene (mg/kg)	190	0.13	1.6	0.00094 J	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Methyl acetate (mg/kg)	7,800	0.58 U	0.16 J	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Methyl tert-butyl ether (MTBE) (mg/kg)	47	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
Methylcyclohexane (mg/kg)		0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.00037 J	0.0015 U	0.00039 J	0.0025 U
Methylene chloride (mg/kg)	35	0.22	1.3 J	0.00082 J	0.002	0.0036	0.0023	0.00099 J	0.0024	0.0061
n-Butylbenzene (mg/kg)	390									
n-Hexane (mg/kg)	61									
n-Propylbenzene (mg/kg)	380									
Pentafluorobenzene (mg/kg)										
p-Isopropyltoluene (mg/kg)										
sec-Butylbenzene (mg/kg)	780									
Styrene (mg/kg)	600	0.07 J	7 U	0.0015	0.003	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U

Table F-2

Table F-2 - Soil Quality Data

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Preliminary Soil PRG	SP03 5/12/08 (4.3-5ft)	SP03 5/12/08 (5-6.5ft)	SP03 5/12/08 (13.5-15ft)	SP03 5/12/08 (18.5-20ft)	SP03 5/12/08 (23.5-25ft)	SP03 5/12/08 (28.5-30ft)	SP03 5/12/08 (33.5-35ft)	SP03 5/12/08 (38.5-40ft)	SP03 5/12/08 (43.5-45ft)
tert-Butylbenzene (mg/kg)	780									
Tetrachloroethene (PCE) (mg/kg)	8.1	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.00045 J	0.0015 U	0.00044 J	0.0025 U
Toluene (mg/kg)	490	7.5	3.3	0.00098 J	0.001 J	0.0021	0.0021	0.0012 J	0.0029	0.0025 U
trans-1,2-Dichloroethene (mg/kg)	160	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
trans-1,3-Dichloropropene (mg/kg)		0.58 U	0.93 J	0.0013 U	0.0012 U	0.0016 U	0.00063 J	0.0015 U	0.00064 J	0.0025 U
Trichloroethene (TCE) (mg/kg)	0.41	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.00044 J	0.0015 U	0.00044 J	0.0025 U
Trichlorofluoromethane (mg/kg)	2,300	0.58 U	7 U	0.0013 U	0.0012 U	0.0019	0.0024	0.0078	0.0045	0.0025 U
Vinyl chloride (mg/kg)	0.059	0.58 U	7 U	0.0013 U	0.0012 U	0.0016 U	0.0018 U	0.0015 U	0.0019 U	0.0025 U
m,p-Xylenes (mg/kg)		5.7	57	0.014	0.008	0.0016 U	0.00052 J	0.0023	0.00066 J	0.0025 U
o-Xylene (mg/kg)	65	3.4	55	0.014	0.0065	0.0016 U	0.00049 J	0.0015 U	0.0009 J	0.0025 U
Xylenes (total) (mg/kg)	58									
Polychlorinated Biphenyls (PCBs)										
Aroclor 1016 (mg/kg)	0.41									
Aroclor 1221 (mg/kg)	0.2									
Aroclor 1232 (mg/kg)	0.17									
Aroclor 1242 (mg/kg)	0.23									
Aroclor 1248 (mg/kg)	0.23									
Aroclor 1254 (mg/kg)	0.12									
Aroclor 1260 (mg/kg)	0.24									
Aroclor 1262 (mg/kg)										
Aroclor 1268 (mg/kg)										

Notes
Concentrations in shaded cells indicate value exceeds Soil PRG.
Where a sample has multiple results for a given analyte (tested for in multiple methods) the highest detected value is shown. Where all results were non-detects, the result with the lowest detection limit is shown.
J = Analyte was positively identified. The reported result is an estimate.
JQ = Approximate value due to quality control problems.
PRG = preliminary remediation goal
QP = Hydrocarbon result partly due to individual peak(s) in quantitation range.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

		BGW-RE-GP-02	BGW-RE-GP-02	BGW-RE-GP-02	BGW-RE-GP-02	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-03	BGW-RE-GP-04	BGW-RE-GP-04	BGW-RE-GP-05	BGW-RE-GP-05	BGW-RE-GP-05	BGW-RE-GP-05	BGW-RE-GP-06	BGW-RE-GP-06									
Chemical Name	Sediment Initial PRG	9/3/13 (0-1.4 ft)	FD 9/3/13 (0-1.4 ft)	9/3/13 (1-1.3 ft)	9/3/13 (1.4-4 ft)	9/3/13 (0-2.3 ft)	9/3/13 (0.8-1.4 ft)	9/3/13 (2.3-3.2 ft)	9/3/13 (2.3-4 ft)	9/3/13 (2.3-4 ft)	9/3/13 (4-5 ft)	9/3/13 (0-2.2 ft)	9/3/13 (2.2-4 ft)	9/3/13 (0-1.5 ft)	9/3/13 (0.4-1.2 ft)	9/3/13 (1.5-4 ft)	9/3/13 (4-5 ft)	9/3/13 (0.8-2.3 ft)	9/3/13 (2.3-4 ft)										
Conventional Chemistry Parameters																													
Total Organic Carbon in Percent		3.69	7.08		0.091	1.92			3.87	6.89	0.051	0.066	0.116	5.3		0.176	0.15	11.9	0.151										
Total Solids in Percent		83.53	84.25		83.16	81.49			84.55	84.37	83.87	84.87	94.35	77.73		89.63	88.96	82.7	90.96										
Polycyclic Aromatic Hydrocarbons (PAHs)																													
Acenaphthene in ug/kg	500	13,000	9,300		1.5	19,000			76,000	79,000	19	3.6	2.7	130,000		110	82	12,000	1.2										
Acenaphthylene in ug/kg	1,300	160,000	120,000		65	87,000			840,000	730,000	100	24	J	32	8,600	21	31	32,000	7.4										
Anthracene in ug/kg	960	180,000	140,000		64	160,000			680,000	430,000	150	20	J	2.8	110,000	45	88	24,000	1.3										
Benzo(g,h,i)perylene in ug/kg	670	150,000	88,000		110	35,000			150,000	150,000	36	48		73	93,000	41	78	49,000	2.5										
Dibenzofuran in ug/kg	540	16,000	11,000		4.6	11,000			69,000	68,000	19	21	J	1.6	6,100	13	15	3,200	1.4										
Fluoranthene in ug/kg	1,700	410,000	340,000		240	140,000			770,000	680,000	230	130		29	350,000	220	350	140,000	15										
Fluorene in ug/kg	540	150,000	88,000		28	110,000			600,000	510,000	72	7.9	J	5.5	12,000	44	36	14,000	2.1										
Phenanthrene in ug/kg	1,500	580,000	380,000		290	280,000			1,700,000	1,500,000	720	320		16	390,000	130	240	130,000	12										
Pyrene in ug/kg	2,600	680,000	550,000		370	210,000			1,200,000	1,100,000	360	180		40	440,000	320	500	160,000	17										
Naphthalene in ug/kg	2,100	49,000	33,000	400,000	32	15,000	1,800	120,000	1,700,000	1,500,000	58	220		41	27,000	46	63	20,000	22										
Benz(a)anthracene in ug/kg	1,300	210,000	170,000		95	54,000			280,000	250,000	51	57		16	110,000	30	72	40,000	1.4										
Benzo(a)pyrene in ug/kg	1,600	220,000	160,000		140	54,000			280,000	240,000	52	56		60	130,000	34	76	55,000	1.6										
Benzo(b)fluoranthene in ug/kg	10,400	86,000	66,000		73	25,000			110,000	110,000	23	42	J	34	65,000	20	45	25,000	1.2										
Benzo(k)fluoranthene in ug/kg	240	46,000	39,000		34	14,000			59,000	64,000	15	19	J	12	30,000	7.5	26	14,000	0.5										
Chrysene in ug/kg	1,400	200,000	150,000		91	48,000			260,000	220,000	51	73		18	110,000	32	120	45,000	2										
Dibenzo(a,h)anthracene in ug/kg	230	22,000	J	16,000	J	20	J	7,500	J	30,000	J	27,000	J	6.5	J	11	J	11	J	5,700	J	0.3	J						
Indeno(1,2,3-cd)pyrene in ug/kg	600	72,000	53,000		72	21,000			91,000	89,000	26	43	J	48	47,000	27	51	24,000	1.5										
Total cPAHs TEQ (ND = 0) in ug/kg	1,600	279,460	J	205,440	J	184.431	J	71,688	J	358,950	J	312,760	J	68.7	J	81.463	J	81.938	J	162,610	J	46.1	J	104.18	J	69,785	J	2.3	J
Total cPAHs TEQ (ND = 1/2 RDL) in ug/kg	1,600	279,460	J	205,440	J	184.431	J	71,688	J	358,950	J	312,760	J	68.7	J	81.463	J	81.938	J	162,610	J	46.1	J	104.18	J	69,785	J	2.3	J
Total HPAHs in ug/kg	12,000	2,145,000	J	1,669,000	J	1,283	J	621,500	J	3,294,000	J	2,993,000	J	864.5	J	681	J	355	J	1,415,000	J	743.5	J	1,352	J	571,700	J	43.5	J
Total LPAHs in ug/kg	5,200	1,132,000	770,300		480.5	671,000			5,596,000	4,749,000	1,119	595.5	J	100	677,600	413	541	232,000	46										
Total PAHs in ug/kg	4,022	3,277,000	J	2,439,300	J	1,764	J	1,292,500	J	8,890,000	J	7,742,000	J	1,984	J	1,277	J	455	J	2,092,600	J	1,157	J	1,893	J	803,700	J	89.5	J
Other (Non-PAH) Semivolatiles																													
1,2,4-Trichlorobenzene in ug/kg	31			16,000	U			390	U	6,700	U					6.1	U												
1,2-Dichlorobenzene in ug/kg	35			3,300	U			78	U	1,300	U					1.2	U												
1,3-Dichlorobenzene in ug/kg	842			33	U			78	U	13	U					1.2	U												
1,4-Dichlorobenzene in ug/kg	110			3,300	U			78	U	1,300	U					1.2	U												
Hexachlorobutadiene in ug/kg	11			16,000	U			390	U	6,700	U					6.1	U												
Volatile Organic Compounds (VOC)																													
1,1,1,2-Tetrachloroethane in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
1,1,1-Trichloroethane in ug/kg	856			3,300	U			78	U	1,300	U					1.2	U												
1,1,2 - Trichlorotrifluoroethane in ug/kg				6,600	U			160	U	2,700	U					2.4	U												
1,1,2,2-Tetrachloroethane in ug/kg	202			3,300	U			78	U	1,300	U					1.2	U												
1,1,2-Trichloroethane in ug/kg	570			3,300	U			78	U	1,300	U					1.2	U												
1,1-Dichloroethane in ug/kg	0.575			3,300	U			78	U	1,300	U					1.2	U												
1,1-Dichloroethene in ug/kg	2,780			3,300	U			78	U	1,300	U					1.2	U												
1,1-Dichloropropene in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
1,2,3-Trichlorobenzene in ug/kg	858			16,000	U			390	U	6,700	U					6.1	U												
1,2,3-Trichloropropane in ug/kg				6,600	U			160	U	2,700	U					2.4	U												
1,2,4-Trimethylbenzene in ug/kg				3,300	U			78	U	980	J					2.4													
1,2-Dibromo-3-chloropropane in ug/kg				16,000	U			390	U	6,700	U					6.1	U												
1,2-Dibromoethane (EDB) in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
1,2-Dichloroethane (EDC) in ug/kg	260			3,300	U			78	U	1,300	U					1.2	U												
1,2-Dichloropropane in ug/kg	333			3,300	U			78	U	1,300	U					1.2	U												
1,3,5-Trimethylbenzene in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
1,3-Dichloropropane in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
1,4-Dichloro-2-Butene in ug/kg				16,000	U			390	U	6,700	U					6.1	U												
2,2-Dichloropropane in ug/kg				3,300	U			78	U	1,300	U					1.2	U												
2-Butanone in ug/kg	42.4			16,000	U			390	U	6,700	U					6.1	U												
2-Chloroethyl Vinyl Ether in ug/kg				16,000	UJ			390	UJ	6,700	UJ					6.1	UJ												

Table F-3A

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Sediment Initial PRG	BGW-RE-GP-02 9/3/13 (0-1.4 ft)	BGW-RE-GP-02 FD 9/3/13 (0-1.4 ft)	BGW-RE-GP-02 9/3/13 (1-1.3 ft)	BGW-RE-GP-02 9/3/13 (1.4-4 ft)	BGW-RE-GP-03 9/3/13 (0-2.3 ft)	BGW-RE-GP-03 9/3/13 (0.8-1.4 ft)	BGW-RE-GP-03 9/3/13 (2.3-3.2 ft)	BGW-RE-GP-03 9/3/13 (2.3-4 ft)	BGW-RE-GP-03 FD 9/3/13 (2.3-4 ft)	BGW-RE-GP-03 9/3/13 (4-5 ft)	BGW-RE-GP-04 9/3/13 (0-2.2 ft)	BGW-RE-GP-04 9/3/13 (2.2-4 ft)	BGW-RE-GP-05 9/3/13 (0-1.5 ft)	BGW-RE-GP-05 9/3/13 (0.4-1.2 ft)	BGW-RE-GP-05 9/3/13 (1.5-4 ft)	BGW-RE-GP-05 9/3/13 (4-5 ft)	BGW-RE-GP-06 9/3/13 (0.8-2.3 ft)	BGW-RE-GP-06 9/3/13 (2.3-4 ft)
2-Chlorotoluene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
2-Hexanone in ug/kg	58.2			16,000 U			390 U	6,700 U							6.1 U				
4-Chlorotoluene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
4-Methyl-2-pentanone in ug/kg	25.1			16,000 U			390 U	6,700 U							6.1 U				
Acetone in ug/kg	9.9			16,000 U			390 U	6,700 U							6.1 U				
Acrolein in ug/kg	0.00152			160,000 U			3,900 U	67,000 U							61 U				
Acrylonitrile in ug/kg	1.2			16,000 U			390 U	6,700 U							6.1 U				
Benzene in ug/kg	137			3,300 U			78 U	1,300 U							8.1				
Bromobenzene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Bromochloromethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Bromodichloromethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Bromoethane in ug/kg				6,600 U			160 U	2,700 U							2.4 U				
Bromoform in ug/kg	1,310			3,300 U			78 U	1,300 U							1.2 U				
Bromomethane in ug/kg	1.37			6,600 U			160 U	2,700 U							1.2 U				
Carbon disulfide in ug/kg	0.851			3,300 U			78 U	1,300 U							4.3				
Carbon tetrachloride in ug/kg	7,240			3,300 U			78 U	1,300 U							1.2 U				
Chlorobenzene in ug/kg	162			3,300 U			78 U	1,300 U							1.2 U				
Chloroethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Chloroform in ug/kg	121			3,300 U			78 U	1,300 U							1.2 U				
Chloromethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
cis-1,2-Dichloroethene (DCE) in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
cis-1,3-Dichloropropene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Dibromochloromethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Dibromomethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Ethylbenzene in ug/kg	305			3,300 U			78 U	1,300 U							24				
Isopropylbenzene in ug/kg	86			3,300 U			78 U	1,300 U							9				
Methylene chloride in ug/kg	159			18,000 U			160 U	6,800 U							4.9 U				
Methyliodide in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
n-Butylbenzene in ug/kg				3,300 U			84	1,300 U							1.2 U				
n-Propylbenzene in ug/kg				3,300 U			78 U	1,300 U							8.3				
p-Isopropyltoluene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
sec-Butylbenzene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Styrene in ug/kg	7,070			3,300 U			78 U	1,300 U							1.2 U				
tert-Butylbenzene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Tetrachloroethene (PCE) in ug/kg	190			3,300 U			78 U	1,300 U							1.2 U				
Toluene in ug/kg	1,090			3,300 U			78 U	1,300 U							1.5				
trans-1,2-Dichloroethene in ug/kg	1,050			3,300 U			78 U	1,300 U							1.2 U				
trans-1,3-Dichloropropene in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Trichloroethene (TCE) in ug/kg	8,950			3,300 U			78 U	1,300 U							1.2 U				
Trichlorofluoromethane in ug/kg				3,300 U			78 U	1,300 U							1.2 U				
Vinyl acetate in ug/kg	13			16,000 U			390 U	6,700 U							6.1 U				
Vinyl chloride in ug/kg	202			3,300 U			78 U	1,300 U							1.2 U				
m,p-Xylenes in ug/kg				6,600 U			160 U	2,700 U											
o-Xylene in ug/kg				3,300 U			78 U	1,300 U							3.9				

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

	Sediment Initial PRG	BGW-RE-GP-07 9/3/13 (0-2.1 ft)	BGW-RE-GP-07 9/3/13 (2.1-5 ft)	BGW-RE-GP-08 9/3/13 (0-2.7 ft)	BGW-RE-GP-08 9/3/13 (2.7-5 ft)	BGW-RE-SG-01 7/8/13 (0-4 in)	BGW-RE-SG-02 7/8/13 (0-4 in)	BGW-RE-SG-03 7/8/13 (0-4 in)	BGW-RE-SG-04 7/8/13 (0-4 in)	BGW-RE-SG-04 7/8/13 (4-12 in)	BGW-RE-SG-05 7/8/13 (0-4 in)	BGW-RE-SG-06 7/8/13 (0-4 in)	BGW-RE-SG-07 7/8/13 (0-4 in)	BGW-RE-SG-08 7/8/13 (0-4 in)	BGW-RE-SG-08 FD 7/8/13 (0-4 in)	BGW-RE-SG-09 7/8/13 (0-4 in)	BGW-RE-SG-10 7/8/13 (0-4 in)	BGW-RE-SG-11 7/8/13 (0-4 in)	BGW-RE-SG-12 7/8/13 (0-4 in)
Conventional Chemistry Parameters																			
Total Organic Carbon in Percent		0.635	0.127	0.521	0.127	6.79 J	1.61 J	3.52 J	5.15 J	2.45	12.6 J	3.66 J	4.69 J	9.31 J	4.98	3.83 J	2.89 J	3.28 J	2.34 J
Total Solids in Percent		88.92	84.08	83.26	92.41	80.14	80.02	80.46	77.2	75.6	70.92	79.4	81.32	78.02	81.48	74.83	78.34	77.27	77.52
Polycyclic Aromatic Hydrocarbons (PAHs)																			
Acenaphthene in ug/kg	500	73	0.4 J	4.4	0.5 U	220	330	220	17,000	21,000	160,000	340	59	150	280	100	94	260	120
Acenaphthylene in ug/kg	1,300	97	0.7	26	0.8	2,000	2,600	1,300	14,000	27,000	42,000	1,700	1,200	4,500	7,000	2,000	1,200	2,700	890
Anthracene in ug/kg	960	81	0.3 J	24	0.3 J	1,800	2,600	1,300	35,000	61,000	180,000	1,600	1,000	3,500	5,200	1,400	1,900	3,000	890
Benzo(g,h,i)perylene in ug/kg	670	760	0.9	190	1.4	13,000	10,000	11,000	14,000	25,000	260,000	9,000	5,600	21,000	16,000	8,100	8,000	10,000	3,600
Dibenzofuran in ug/kg	540	25	0.3 J	9.6	0.3 J	280	310	220	3,000	6,200	13,000	280	220	520	1,100	260	250	360	180
Fluoranthene in ug/kg	1,700	1,400	1.6	320	2.3	24,000	24,000	22,000	61,000	100,000	1,100,000	18,000	9,900	36,000	32,000	13,000	14,000	20,000	8,200
Fluorene in ug/kg	540	48	0.3 J	5.8	0.5 U	1,000	1,200	580	33,000	61,000	42,000	970	540	1,100	2,000	780	680	1,400	520
Phenanthrene in ug/kg	1,500	370	3	170	2.6	11,000	10,000	7,600	120,000	230,000	490,000	9,100	7,000	17,000	27,000	7,800	7,900	16,000	4,300
Pyrene in ug/kg	2,600	1,600	1.6	280	2.5	36,000	31,000	32,000	95,000	140,000	1,400,000	24,000	15,000	47,000	34,000	20,000	22,000	28,000	13,000
Naphthalene in ug/kg	2,100	250	5.4	87	14	1,500	1,200	980	10,000	9,000	52,000	1,200	1,100	3,800	16,000	1,300	1,200	2,500	1,200
Benzo(a)anthracene in ug/kg	1,300	580	0.3 J	100	1.1	12,000	12,000	11,000	22,000	37,000	310,000	9,100	5,100	23,000	17,000	8,400	7,500	9,400	4,000
Benzo(a)pyrene in ug/kg	1,600	730	0.5 J	150	1.2	13,000	13,000	14,000	22,000	35,000	400,000	10,000	5,500	26,000	16,000	9,400	9,300	11,000	4,300
Benzo(b)fluoranthene in ug/kg	10,400	430	0.4 J	120	0.9	9,600	8,400	8,600	12,000	18,000	200,000	7,000	4,300	18,000	12,000	6,600	5,900	7,400	2,800
Benzo(k)fluoranthene in ug/kg	240	200	0.5 U	46	0.5	4,600	4,100	4,000	6,500	11,000	93,000	3,300	2,200	7,800	6,100	3,300	2,900	3,500	1,500
Chrysene in ug/kg	1,400	600	0.5 J	150	1.4	13,000	11,000	11,000	24,000	45,000	270,000	9,200	5,500	25,000	22,000	8,700	7,900	11,000	4,200
Dibenzo(a,h)anthracene in ug/kg	230	88 J	0.5 U	26 J	0.2 J	1,500	1,200	1,200	1,900	4,000	38,000	1,000	660	3,200	2,800	900	700	750	330
Indeno(1,2,3-cd)pyrene in ug/kg	600	510	0.4 J	120	1	8,800	7,300	8,000	9,500	17,000	190,000	6,300	3,900	14,000	11,000	5,500	5,300	7,100	1,200
Total cPAHs TEQ (ND = 0) in ug/kg	1,600	972.6 J	0.6 J	210.61 J	1.7 J	17,599	17,022	18,011	28,339	46,355	509,200	13,282	7,518	34,803	22,883	12,392	11,907	14,186	5,449
Total cPAHs TEQ (ND = 1/2 RDL) in ug/kg	1,600	972.6 J	0.9 J	210.61 J	1.7 J	17,599	17,022	18,011	28,339	46,355	509,200	13,282	7,518	34,803	22,883	12,392	11,907	14,186	5,449
Total HPAHs in ug/kg	12,000	7,148 J	6.2 J	1,555 J	13 J	140,400	126,600	127,200	274,100	442,000	4,361,000	100,300	59,760	229,700	175,000	87,400	86,500	112,050	44,530
Total LPAHs in ug/kg	5,200	919	10.1 J	317.2	17.7 J	17,520	17,930	11,980	229,000	409,000	966,000	14,910	10,899	30,050	57,480	13,380	12,974	25,860	7,920
Total PAHs in ug/kg	4,022	8,067 J	16.3 J	1,872 J	30.7 J	157,920	144,530	139,180	503,100	851,000	5,327,000	115,210	70,659	259,750	232,480	100,780	99,474	137,910	52,450
Other (Non-PAH) Semivolatiles																			
1,2,4-Trichlorobenzene in ug/kg	31																		
1,2-Dichlorobenzene in ug/kg	35																		
1,3-Dichlorobenzene in ug/kg	842																		
1,4-Dichlorobenzene in ug/kg	110																		
Hexachlorobutadiene in ug/kg	11																		
Volatile Organic Compounds (VOC)																			
1,1,1,2-Tetrachloroethane in ug/kg																			
1,1,1-Trichloroethane in ug/kg	856																		
1,1,2 - Trichlorotrifluoroethane in ug/kg																			
1,1,2,2-Tetrachloroethane in ug/kg	202																		
1,1,2-Trichloroethane in ug/kg	570																		
1,1-Dichloroethane in ug/kg	0.575																		
1,1-Dichloroethene in ug/kg	2,780																		
1,1-Dichloropropene in ug/kg																			
1,2,3-Trichlorobenzene in ug/kg	858																		
1,2,3-Trichloropropane in ug/kg																			
1,2,4-Trimethylbenzene in ug/kg																			
1,2-Dibromo-3-chloropropane in ug/kg																			
1,2-Dibromoethane (EDB) in ug/kg																			
1,2-Dichloroethane (EDC) in ug/kg	260																		
1,2-Dichloropropane in ug/kg	333																		
1,3,5-Trimethylbenzene in ug/kg																			
1,3-Dichloropropane in ug/kg																			
1,4-Dichloro-2-Butene in ug/kg																			
2,2-Dichloropropane in ug/kg																			
2-Butanone in ug/kg	42.4																		
2-Chloroethyl Vinyl Ether in ug/kg																			

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation
Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Sediment Initial PRG	BGW-RE-GP-07 9/3/13 (0-2.1 ft)	BGW-RE-GP-07 9/3/13 (2.1-5 ft)	BGW-RE-GP-08 9/3/13 (0-2.7 ft)	BGW-RE-GP-08 9/3/13 (2.7-5 ft)	BGW-RE-SG-01 7/8/13 (0-4 in)	BGW-RE-SG-02 7/8/13 (0-4 in)	BGW-RE-SG-03 7/8/13 (0-4 in)	BGW-RE-SG-04 7/8/13 (0-4 in)	BGW-RE-SG-04 7/8/13 (4-12 in)	BGW-RE-SG-05 7/8/13 (0-4 in)	BGW-RE-SG-06 7/8/13 (0-4 in)	BGW-RE-SG-07 7/8/13 (0-4 in)	BGW-RE-SG-08 7/8/13 (0-4 in)	BGW-RE-SG-08 FD 7/8/13 (0-4 in)	BGW-RE-SG-09 7/8/13 (0-4 in)	BGW-RE-SG-10 7/8/13 (0-4 in)	BGW-RE-SG-11 7/8/13 (0-4 in)	BGW-RE-SG-12 7/8/13 (0-4 in)
2-Chlorotoluene in ug/kg																			
2-Hexanone in ug/kg	58.2																		
4-Chlorotoluene in ug/kg																			
4-Methyl-2-pentanone in ug/kg	25.1																		
Acetone in ug/kg	9.9																		
Acrolein in ug/kg	0.00152																		
Acrylonitrile in ug/kg	1.2																		
Benzene in ug/kg	137																		
Bromobenzene in ug/kg																			
Bromochloromethane in ug/kg																			
Bromodichloromethane in ug/kg																			
Bromoethane in ug/kg																			
Bromoform in ug/kg	1,310																		
Bromomethane in ug/kg	1.37																		
Carbon disulfide in ug/kg	0.851																		
Carbon tetrachloride in ug/kg	7,240																		
Chlorobenzene in ug/kg	162																		
Chloroethane in ug/kg																			
Chloroform in ug/kg	121																		
Chloromethane in ug/kg																			
cis-1,2-Dichloroethene (DCE) in ug/kg																			
cis-1,3-Dichloropropene in ug/kg																			
Dibromochloromethane in ug/kg																			
Dibromomethane in ug/kg																			
Ethylbenzene in ug/kg	305																		
Isopropylbenzene in ug/kg	86																		
Methylene chloride in ug/kg	159																		
Methyliodide in ug/kg																			
n-Butylbenzene in ug/kg																			
n-Propylbenzene in ug/kg																			
p-Isopropyltoluene in ug/kg																			
sec-Butylbenzene in ug/kg																			
Styrene in ug/kg	7,070																		
tert-Butylbenzene in ug/kg																			
Tetrachloroethene (PCE) in ug/kg	190																		
Toluene in ug/kg	1,090																		
trans-1,2-Dichloroethene in ug/kg	1,050																		
trans-1,3-Dichloropropene in ug/kg																			
Trichloroethene (TCE) in ug/kg	8,950																		
Trichlorofluoromethane in ug/kg																			
Vinyl acetate in ug/kg	13																		
Vinyl chloride in ug/kg	202																		
m,p-Xylenes in ug/kg																			
o-Xylene in ug/kg																			

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

	Sediment Initial PRG	BGW-RE-SG-13 7/8/13 (0-4 in)	BGW-RE-SG-14 7/8/13 (0-4 in)	BGW-RE-SG-15 7/8/13 (0-4 in)	BGW-RE-SG-15 FD 7/8/13 (0-4 in)	BGW-RE-SG-15 7/8/13 (4-10 in)	BGW-RE-SG-16 7/8/13 (0-4 in)	BGW-RE-SG-17 7/8/13 (0-4 in)	BGW-RE-SG-17 7/8/13 (4-9 in)	BGW-RE-SG-18 7/8/13 (0-4 in)	BGW-RE-SG-19 7/8/13 (0-4 in)	BGW-RE-SG-19 7/8/13 (4-8 in)	BGW-RE-SG-20 7/8/13 (0-4 in)	BGW-RE-SG-21 7/8/13 (0-4 in)	BGW-RE-SG-22 7/8/13 (0-4 in)	BGW-RE-SG-22 7/8/13 (4-10 in)	BGW-RE-SG-23 7/8/13 (0-4 in)	BGW-RE-SG-24 7/8/13 (0-4 in)	BGW-RE-SG-25 7/8/13 (0-4 in)	
Conventional Chemistry Parameters																				
Total Organic Carbon in Percent		5.18 J	1.59 J	5.54 J	3.93	1.36	1.75	3.14	1.97	0.514	2.29	1.14	2.92	0.444	2	1.13	2.66	0.207	16.9	
Total Solids in Percent		76.12	83.35	69.85	69.56	70.88	75.82	87.5	84.59	89.99	69.43	85.36	64.21	91.67	80.23	79.32	79.19	88.68	79.23	
Polycyclic Aromatic Hydrocarbons (PAHs)																				
Acenaphthene in ug/kg	500	190	36	960 J	540	490	150	140	280	72	120	340	960	5.5	44	170 J	270	4.7 U	29	
Acenaphthylene in ug/kg	1,300	1,600	460 J	6,400	3,000	4,600	3,200	2,000	3,200	200	920	2,200	7,600	32	440	1,200 J	2,200	12	350 J	
Anthracene in ug/kg	960	1,700	440	7,400	4,300	6,700	2,800	1,300	2,700	180	890	2,300	8,100	24 J	440	1,300 J	2,400	8.6	310 J	
Benzo(g,h,i)perylene in ug/kg	670	5,500	2,000	20,000	12,000	12,000	8,400	3,500	10,000	570	2,600	6,400	39,000	98	1,700	3,800 J	6,500	72	1,700	
Dibenzofuran in ug/kg	540	390	80	1,200	840	580	360	230	370	110	95	260	670	3.8 J	65	120	270	4.7 U	45	
Fluoranthene in ug/kg	1,700	14,000	3,900	45,000	29,000	29,000	16,000	13,000	23,000	970	5,700	18,000	87,000	230	3,700	13,000	16,000	130	3,300	
Fluorene in ug/kg	540	1,200	210 J	3,500	1,400	1,700	1,000	1,000	1,600	93	470	930	1,900	22	200	540 J	1,600	3.5 J	100 J	
Phenanthrene in ug/kg	1,500	8,600	1,600	29,000	14,000	13,000	11,000	12,000	12,000	860	3,200	7,100	27,000	170	1,900	4,400 J	15,000	54	1,200	
Pyrene in ug/kg	2,600	20,000	5,700	64,000	36,000	36,000	23,000	18,000	31,000	1,600	8,300	24,000	120,000	350	4,900	18,000	24,000	180	4,400	
Naphthalene in ug/kg	2,100	2,200	650	7,100	4,400	3,100	6,400	1,200	3,000	890	580	1,700	4,400	8.6	410	880 J	1,400	11	340 J	
Benzo(a)anthracene in ug/kg	1,300	6,800	2,600	23,000	13,000	15,000	10,000	5,000	10,000	480	2,700	8,600	47,000	100	1,700	5,600 J	7,300	60	1,500	
Benzo(a)pyrene in ug/kg	1,600	7,000	2,700	24,000	14,000	16,000	10,000	4,200	12,000	620	3,000	8,500	50,000	130	2,000	4,400 J	7,800	80	1,800	
Benzo(b)fluoranthene in ug/kg	10,400	4,600	1,700	16,000	9,500	8,900	6,300	2,900	7,600	340	1,800	5,100	29,000	74	1,200	2,900 J	5,200	48	1,100	
Benzo(k)fluoranthene in ug/kg	240	2,300	760	8,700	4,700	5,300	3,400	1,600	3,800	180	1,000	3,000	18,000	40 J	650	1,700 J	2,800	25	650	
Chrysene in ug/kg	1,400	7,000	2,800	24,000	16,000	17,000	11,000	5,100	12,000	530	3,200	9,000	48,000	130	2,100	5,600 J	9,400	74	1,800	
Dibenzo(a,h)anthracene in ug/kg	230	940	180	3,600	1,900	2,300	1,400	670	1,800	99	490	1,200	5,900	18	250	670 J	1,100	12	240	
Indeno(1,2,3-cd)pyrene in ug/kg	600	3,900	1,400	14,000	7,900	8,600	5,900	2,400	7,500	390	1,700	4,500	27,000	70	1,100	2,600 J	4,200	50	1,100	
Total cPAHs TEQ (ND = 0) in ug/kg	1,600	9,500	3,460	33,011	19,003	21,620	13,665	5,921	16,360	842.33	4,123	11,559	66,428	172.93 J	2,659	6,203 J	10,607	108.124	2,418	
Total cPAHs TEQ (ND = 1/2 RDL) in ug/kg	1,600	9,500	3,460	33,011	19,003	21,620	13,665	5,921	16,360	842.33	4,123	11,559	66,428	172.93 J	2,659	6,203 J	10,607	108.124	2,418	
Total HPAHs in ug/kg	12,000	74,540	24,500	250,600	149,000	155,300	99,200	58,070	123,000	5,979	31,590	91,200	486,900	1,286 J	19,980	59,970 J	87,200	759	18,210	
Total LPAHs in ug/kg	5,200	15,490	3,396 J	54,360 J	27,640	29,590	24,550	17,640	22,780	2,295	6,180	14,570	49,960	262.1 J	3,434	8,490 J	22,870	89.1 J	2,329 J	
Total PAHs in ug/kg	4,022	90,030	27,896 J	304,960 J	176,640	184,890	123,750	75,710	145,780	8,274	37,770	105,770	536,860	1,548 J	23,414	68,460 J	110,070	848.1 J	20,539 J	
Other (Non-PAH) Semivolatiles																				
1,2,4-Trichlorobenzene in ug/kg	31																			
1,2-Dichlorobenzene in ug/kg	35																			
1,3-Dichlorobenzene in ug/kg	842																			
1,4-Dichlorobenzene in ug/kg	110																			
Hexachlorobutadiene in ug/kg	11																			
Volatile Organic Compounds (VOC)																				
1,1,1,2-Tetrachloroethane in ug/kg																				
1,1,1-Trichloroethane in ug/kg	856																			
1,1,2 - Trichlorotrifluoroethane in ug/kg																				
1,1,2,2-Tetrachloroethane in ug/kg	202																			
1,1,2-Trichloroethane in ug/kg	570																			
1,1-Dichloroethane in ug/kg	0.575																			
1,1-Dichloroethene in ug/kg	2,780																			
1,1-Dichloropropene in ug/kg																				
1,2,3-Trichlorobenzene in ug/kg	858																			
1,2,3-Trichloropropane in ug/kg																				
1,2,4-Trimethylbenzene in ug/kg																				
1,2-Dibromo-3-chloropropane in ug/kg																				
1,2-Dibromoethane (EDB) in ug/kg																				
1,2-Dichloroethane (EDC) in ug/kg	260																			
1,2-Dichloropropane in ug/kg	333																			
1,3,5-Trimethylbenzene in ug/kg																				
1,3-Dichloropropane in ug/kg																				
1,4-Dichloro-2-Butene in ug/kg																				
2,2-Dichloropropane in ug/kg																				
2-Butanone in ug/kg	42.4																			
2-Chloroethyl Vinyl Ether in ug/kg																				

Table F-3A

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation
Bremerton Gas Works Superfund Site
Bremerton, Washington

		BGW-RE-SG-13	BGW-RE-SG-14	BGW-RE-SG-15	BGW-RE-SG-15	BGW-RE-SG-15	BGW-RE-SG-16	BGW-RE-SG-17	BGW-RE-SG-17	BGW-RE-SG-18	BGW-RE-SG-19	BGW-RE-SG-19	BGW-RE-SG-20	BGW-RE-SG-21	BGW-RE-SG-22	BGW-RE-SG-22	BGW-RE-SG-23	BGW-RE-SG-24	BGW-RE-SG-25
Chemical Name	Sediment Initial PRG	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	FD 7/8/13 (0-4 in)	7/8/13 (4-10 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (4-9 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (4-8 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (4-10 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)	7/8/13 (0-4 in)
2-Chlorotoluene in ug/kg																			
2-Hexanone in ug/kg	58.2																		
4-Chlorotoluene in ug/kg																			
4-Methyl-2-pentanone in ug/kg	25.1																		
Acetone in ug/kg	9.9																		
Acrolein in ug/kg	0.00152																		
Acrylonitrile in ug/kg	1.2																		
Benzene in ug/kg	137																		
Bromobenzene in ug/kg																			
Bromochloromethane in ug/kg																			
Bromodichloromethane in ug/kg																			
Bromoethane in ug/kg																			
Bromoform in ug/kg	1,310																		
Bromomethane in ug/kg	1.37																		
Carbon disulfide in ug/kg	0.851																		
Carbon tetrachloride in ug/kg	7,240																		
Chlorobenzene in ug/kg	162																		
Chloroethane in ug/kg																			
Chloroform in ug/kg	121																		
Chloromethane in ug/kg																			
cis-1,2-Dichloroethene (DCE) in ug/kg																			
cis-1,3-Dichloropropene in ug/kg																			
Dibromochloromethane in ug/kg																			
Dibromomethane in ug/kg																			
Ethylbenzene in ug/kg	305																		
Isopropylbenzene in ug/kg	86																		
Methylene chloride in ug/kg	159																		
Methyliodide in ug/kg																			
n-Butylbenzene in ug/kg																			
n-Propylbenzene in ug/kg																			
p-Isopropyltoluene in ug/kg																			
sec-Butylbenzene in ug/kg																			
Styrene in ug/kg	7,070																		
tert-Butylbenzene in ug/kg																			
Tetrachloroethene (PCE) in ug/kg	190																		
Toluene in ug/kg	1,090																		
trans-1,2-Dichloroethene in ug/kg	1,050																		
trans-1,3-Dichloropropene in ug/kg																			
Trichloroethene (TCE) in ug/kg	8,950																		
Trichlorofluoromethane in ug/kg																			
Vinyl acetate in ug/kg	13																		
Vinyl chloride in ug/kg	202																		
m,p-Xylenes in ug/kg																			
o-Xylene in ug/kg																			

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation

Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Sediment Initial PRG	BGW-RE-SG-25 7/8/13 (4-12 in)	BGW-RE-SG-26 7/8/13 (0-4 in)	BGW-RE-SG-27 7/8/13 (0-4 in)	BGW-RE-SG-28 7/8/13 (0-4 in)	BGW-RE-SG-29 7/8/13 (0-4 in)	BGW-RE-SG-30 7/8/13 (0-4 in)	BGW-RE-SG-31 8/7/13 (0-4 in)	BGW-RE-SG-32 8/7/13 (0-4 in)	BGW-RE-SG-33 8/7/13 (0-4 in)	BGW-RE-SG-34 8/7/13 (0-4 in)	BGW-RE-SG-35 8/7/13 (0-4 in)	BGW-RE-SG-36 8/7/13 (0-4 in)	BGW-RE-SG-37 8/7/13 (0-4 in)	BGW-RE-SG-38 8/7/13 (0-4 in)	BGW-RE-SG-38 FD 8/7/13 (0-4 in)	BGW-RE-SG-39 8/7/13 (0-4 in)
Conventional Chemistry Parameters																	
Total Organic Carbon in Percent		1.14	1.15	0.204	0.25	1.1	1.22	0.594	0.779	6.64	2.97	4	4.84	4.57	4.43	4.6	0.208
Total Solids in Percent		81.67	77.33	86.86	86.96	86.78	78.1	89.23	77.08	76.37	83.41	85.12	86.08	84.14	77.79	85.41	76.75
Polycyclic Aromatic Hydrocarbons (PAHs)																	
Acenaphthene in ug/kg	500	84 J	200	32	0.4 J	7.2	58	24 J	2,100 J	1,400 J	730 J	3,600 J	230 J	380 J	1,500 J	3,200 J	580 J
Acenaphthylene in ug/kg	1,300	1,300	820	240	5.3	78	270	170 J	2,300	6,100	3,900	4,700	5,500	1,900	6,800	8,000	3,400
Anthracene in ug/kg	960	1,800	990	410	3.4	85	350	190 J	2,000	8,200	5,800	7,000	9,400	2,000	6,800	6,200	2,700
Benzo(g,h,i)perylene in ug/kg	670	6,600	2,500	1,500	39	400	1,200	1,200 J	6,400 J	39,000 J	25,000 J	17,000 J	34,000 J	20,000 J	19,000 J	16,000 J	10,000 J
Dibenzofuran in ug/kg	540	160	140	48	0.9	12	57	17	370	630	300	610	440	150	470	490	270
Fluoranthene in ug/kg	1,700	15,000	6,500	3,200	34	790	2,500	2,700	16,000	77,000	58,000	46,000	62,000	40,000	49,000	43,000	20,000
Fluorene in ug/kg	540	440	400	100	1.8	33	160	89 J	1,400	2,600	1,200	3,800	2,100	570	2,400	1,700	890
Phenanthrene in ug/kg	1,500	4,100	4,300	1,300	15	320	1,600	950	8,600	30,000	18,000	37,000	21,000	8,200	16,000	15,000	9,900
Pyrene in ug/kg	2,600	19,000	9,100	4,000	55	1,100	3,300	2,800	22,000	86,000	57,000	47,000	59,000	39,000	55,000	44,000	24,000
Naphthalene in ug/kg	2,100	1,300	940	320	7.5	74	340	200 J	2,800	4,800	3,400	4,200	2,900	1,700	3,300	3,600	2,800
Benz(a)anthracene in ug/kg	1,300	7,200	2,900	1,500	22	360	1,200	1,200 J	9,300	38,000	23,000	18,000	35,000	16,000	24,000	20,000	11,000
Benzo(a)pyrene in ug/kg	1,600	8,000	3,000	2,000	34	420	1,600	1,300	8,200	46,000	27,000	21,000	42,000	22,000	26,000	24,000	11,000
Benzo(b)fluoranthene in ug/kg	10,400	4,400	1,800	1,200	21	260	940	770 J	4,800	25,000	15,000	11,000	22,000	12,000	13,000	13,000	6,800
Benzo(k)fluoranthene in ug/kg	240	2,600	940	630	10	140	470	290 J	2,500	14,000	8,100	5,900	12,000	6,200	6,600	6,200	3,300
Chrysene in ug/kg	1,400	8,100	3,200	1,700	28	380	1,400	1,100	8,200	40,000	23,000	18,000	37,000	18,000	23,000	21,000	11,000
Dibenzo(a,h)anthracene in ug/kg	230	1,000	390	280	5.8	72	240	150 J	960	4,300	120	1,800	6,000	1,900	3,400	1,900	1,100
Indeno(1,2,3-cd)pyrene in ug/kg	600	4,400	1,600	1,100	25	280	890	840 J	4,900 J	29,000 J	18,000 J	13,000 J	24,000 J	14,000 J	13,000 J	12,000 J	7,400 J
Total cPAHs TEQ (ND = 0) in ug/kg	1,600	10,634	4,033	2,668	46.7	583.78	2,149	1,735 J	11,093 J	59,680 J	32,824 J	27,077 J	56,257 J	28,180 J	34,489 J	30,483 J	14,664 J
Total cPAHs TEQ (ND = 1/2 RDL) in ug/kg	1,600	10,634	4,033	2,668	46.7	583.78	2,149	1,735 J	11,093 J	59,680 J	32,824 J	27,077 J	56,257 J	28,180 J	34,489 J	30,483 J	14,664 J
Total HPAHs in ug/kg	12,000	78,800	32,900	17,810	284.8	4,362	14,260	12,670 J	86,060 J	412,300 J	262,820 J	205,200 J	346,000 J	195,700 J	239,900 J	208,700 J	109,600 J
Total LPAHs in ug/kg	5,200	9,024 J	7,650	2,402	33.4 J	597.2	2,778	1,623 J	19,200 J	53,100 J	33,030 J	60,300 J	41,130 J	14,750 J	36,800 J	37,700 J	20,270 J
Total PAHs in ug/kg	4,022	87,824 J	40,550	20,212	318.2 J	4,959	17,038	14,293 J	105,260 J	465,400 J	295,850 J	265,500 J	387,130 J	210,450 J	276,700 J	246,400 J	129,870 J
Other (Non-PAH) Semivolatiles																	
1,2,4-Trichlorobenzene in ug/kg	31																
1,2-Dichlorobenzene in ug/kg	35																
1,3-Dichlorobenzene in ug/kg	842																
1,4-Dichlorobenzene in ug/kg	110																
Hexachlorobutadiene in ug/kg	11																
Volatile Organic Compounds (VOC)																	
1,1,1,2-Tetrachloroethane in ug/kg																	
1,1,1-Trichloroethane in ug/kg	856																
1,1,2 - Trichlorotrifluoroethane in ug/kg																	
1,1,2,2-Tetrachloroethane in ug/kg	202																
1,1,2-Trichloroethane in ug/kg	570																
1,1-Dichloroethane in ug/kg	0.575																
1,1-Dichloroethene in ug/kg	2,780																
1,1-Dichloropropene in ug/kg																	
1,2,3-Trichlorobenzene in ug/kg	858																
1,2,3-Trichloropropane in ug/kg																	
1,2,4-Trimethylbenzene in ug/kg																	
1,2-Dibromo-3-chloropropane in ug/kg																	
1,2-Dibromoethane (EDB) in ug/kg																	
1,2-Dichloroethane (EDC) in ug/kg	260																
1,2-Dichloropropane in ug/kg	333																
1,3,5-Trimethylbenzene in ug/kg																	
1,3-Dichloropropane in ug/kg																	
1,4-Dichloro-2-Butene in ug/kg																	
2,2-Dichloropropane in ug/kg																	
2-Butanone in ug/kg	42.4																
2-Chloroethyl Vinyl Ether in ug/kg																	

Table F-3A - Sediment Quality Data - 2013 Removal Evaluation
Bremerton Gas Works Superfund Site
Bremerton, Washington

Chemical Name	Sediment Initial PRG	BGW-RE-SG-25 7/8/13 (4-12 in)	BGW-RE-SG-26 7/8/13 (0-4 in)	BGW-RE-SG-27 7/8/13 (0-4 in)	BGW-RE-SG-28 7/8/13 (0-4 in)	BGW-RE-SG-29 7/8/13 (0-4 in)	BGW-RE-SG-30 7/8/13 (0-4 in)	BGW-RE-SG-31 8/7/13 (0-4 in)	BGW-RE-SG-32 8/7/13 (0-4 in)	BGW-RE-SG-33 8/7/13 (0-4 in)	BGW-RE-SG-34 8/7/13 (0-4 in)	BGW-RE-SG-35 8/7/13 (0-4 in)	BGW-RE-SG-36 8/7/13 (0-4 in)	BGW-RE-SG-37 8/7/13 (0-4 in)	BGW-RE-SG-38 8/7/13 (0-4 in)	BGW-RE-SG-38 FD 8/7/13 (0-4 in)	BGW-RE-SG-39 8/7/13 (0-4 in)
2-Chlorotoluene in ug/kg																	
2-Hexanone in ug/kg	58.2																
4-Chlorotoluene in ug/kg																	
4-Methyl-2-pentanone in ug/kg	25.1																
Acetone in ug/kg	9.9																
Acrolein in ug/kg	0.00152																
Acrylonitrile in ug/kg	1.2																
Benzene in ug/kg	137																
Bromobenzene in ug/kg																	
Bromochloromethane in ug/kg																	
Bromodichloromethane in ug/kg																	
Bromoethane in ug/kg																	
Bromoform in ug/kg	1,310																
Bromomethane in ug/kg	1.37																
Carbon disulfide in ug/kg	0.851																
Carbon tetrachloride in ug/kg	7,240																
Chlorobenzene in ug/kg	162																
Chloroethane in ug/kg																	
Chloroform in ug/kg	121																
Chloromethane in ug/kg																	
cis-1,2-Dichloroethene (DCE) in ug/kg																	
cis-1,3-Dichloropropene in ug/kg																	
Dibromochloromethane in ug/kg																	
Dibromomethane in ug/kg																	
Ethylbenzene in ug/kg	305																
Isopropylbenzene in ug/kg	86																
Methylene chloride in ug/kg	159																
Methyliodide in ug/kg																	
n-Butylbenzene in ug/kg																	
n-Propylbenzene in ug/kg																	
p-Isopropyltoluene in ug/kg																	
sec-Butylbenzene in ug/kg																	
Styrene in ug/kg	7,070																
tert-Butylbenzene in ug/kg																	
Tetrachloroethene (PCE) in ug/kg	190																
Toluene in ug/kg	1,090																
trans-1,2-Dichloroethene in ug/kg	1,050																
trans-1,3-Dichloropropene in ug/kg																	
Trichloroethene (TCE) in ug/kg	8,950																
Trichlorofluoromethane in ug/kg																	
Vinyl acetate in ug/kg	13																
Vinyl chloride in ug/kg	202																
m,p-Xylenes in ug/kg																	
o-Xylene in ug/kg																	

Notes
Concentrations in shaded cells indicate value exceeds the Sediment PRG.
J = Analyte was positively identified. The reported result is an estimate.
PRG = preliminary remediation goal
U = Analyte was not detected at or above the reported result.

Table F-3B - Sediment Quality Data - E+E 2008 Brownfields

Bremerton Gas Works Superfund Site

Bremerton, Washington

Chemical Name	Sediment Initial PRG	WN01 6/4/08 (0-6 ft)	WN02 6/4/08 (0-6 ft)	WN03 6/4/08 (0-6 ft)	WN04 6/4/08 (0-6 ft)	WN05 6/4/08 (0-6 ft)
Total Petroleum Hydrocarbons (TPH)						
Gasoline Range Hydrocarbons in ug/kg		450,000 U	6,000 U	25,000 U	5,000 U	5,000 U
Diesel Range Hydrocarbons in ug/kg		210,000 J	140,000 J	240,000 J	63,000 J	25,000 U
Oil Range Hydrocarbons in ug/kg		450,000 J	460,000 J	620,000 J	210,000 J	21,000 J
Metals						
Aluminum in ug/kg		9,030,000 J	7,130,000 J	7,640,000 J	6,290,000 J	6,020,000 J
Antimony in ug/kg	2,000	3,900 J				
Arsenic in ug/kg	57,000	2,300	2,300	5,100	2,600 J	1,500 J
Barium in ug/kg		19,100 J	30,200 J	47,000 J	16,600 J	13,300 J
Beryllium in ug/kg		2,700	2,100	2,300	2,000	1,900
Cadmium in ug/kg	5,100	700 U	600 U	700 U	500 U	500 U
Calcium in ug/kg		33,600,000 J	5,530,000 J	17,200,000 J	6,140,000 J	2,390,000 J
Chromium (Total) in ug/kg	260,000	21,200 J	19,300 J	20,200 J	17,500 J	16,600 J
Cobalt in ug/kg	50,000	3,700 J	3,900 J	26,300	3,500 J	3,000 J
Copper in ug/kg	390,000	26,700	22,100	71,700	13,500	8,600
Iron in ug/kg	20,000,000	12,500,000 J	14,000,000 J	15,900,000 J	11,400,000 J	9,730,000 J
Lead in ug/kg	450,000	16,100 J	19,400 J	30,000 J	10,100 J	8,900 J
Magnesium in ug/kg		4,210,000	4,640,000	3,970,000	4,110,000	3,350,000
Manganese in ug/kg	460,000	168,000	180,000	166,000	135,000	174,000
Mercury in ug/kg	410	27.8 J	28 J			100 J
Nickel in ug/kg	20,900	26,700 J	33,500 J	52,600 J	25,300 J	21,400 J
Potassium in ug/kg		603,000 J	563,000 J	494,000 J	497,000 J	415,000 J
Selenium in ug/kg	2,000	4,800 U	4,400 U	400 J	3,500 U	3,500 U
Silver in ug/kg	6,100	1,400 U	1,300 U	1,000 U	1,000 U	1,000 U
Sodium in ug/kg		1,390,000	996,000	1,560,000	1,930,000	605,000
Thallium in ug/kg		3,400 U	3,100 U	2,500 U	2,500 U	2,500 U
Vanadium in ug/kg		29,800	27,800	36,500	25,000	21,600
Zinc in ug/kg	410,000	79,900 J	57,400 J	78,900 J	36,500 J	23,200 J
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene in ug/kg	500	380	73	240	97	15
Acenaphthylene in ug/kg	1,300	1,100	1,500	1,700	1,300	230
Anthracene in ug/kg	960	990	1,300	2,300	1,700	140
Benzo(g,h,i)perylene in ug/kg	670	2,100	2,700	3,000	3,800	380
Dibenzofuran in ug/kg	540	74	58	71	69	25 U
Fluorene in ug/kg	540	450	630	770	780	13
Phenanthrene in ug/kg	1,500	2,200	1,900	24,000	8,100 J	430
Pyrene in ug/kg	2,600	5,200	7,100	7,500	1,300	500
2-Methylnaphthalene in ug/kg	670	1,200	470	370	380	19
Naphthalene in ug/kg	2,100	1,300	490	560	300	17 J
Benz(a)anthracene in ug/kg	1,300	3,700	3,200	920	5,600	660
Benzo(a)pyrene in ug/kg	1,600	3,600	3,700	3,400	6,300	410
Benzo(b)fluoranthene in ug/kg	10,400	2,000	2,000	3,100	3,400	440
Benzo(k)fluoranthene in ug/kg	240	2,200	2,600	1,300	3,600	340
Chrysene in ug/kg	1,400	3,400 J	3,500	17,000	6,000	640
Dibenzo(a,h)anthracene in ug/kg	230	600	700 DJ	870	860	150
Indeno(1,2,3-cd)pyrene in ug/kg	600	2,000	2,000	3,100	3,200	360
Total cPAHs TEQ (ND = 0) in ug/kg	1,600	4,680	4,790	4,500	8,030	611
Total cPAHs TEQ (ND = 1/2 RDL) in ug/kg	1,600	4,680	4,790	4,500	8,030	611

Table F-3B

Table F-3B - Sediment Quality Data - E+E 2008 Brownfields

Bremerton Gas Works Superfund Site

Bremerton, Washington

Chemical Name	Sediment Initial PRG	WN01 6/4/08 (0-6 ft)	WN02 6/4/08 (0-6 ft)	WN03 6/4/08 (0-6 ft)	WN04 6/4/08 (0-6 ft)	WN05 6/4/08 (0-6 ft)
Other (Non-PAH) Semivolatiles						
1,1'-Biphenyl in ug/kg	1,220	110	71	90	60	25 U
1,2,4,5-Tetrachlorobenzene in ug/kg	47,000	25 U	26 U	27 U	25 U	25 U
1,2,4-Trichlorobenzene in ug/kg	31	6.6 U	9 U	7.8 U	6.8 U	7.1 U
1,2-Dichlorobenzene in ug/kg	35	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,3-Dichlorobenzene in ug/kg	842	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,4-Dichlorobenzene in ug/kg	110	17 J	23 J	21 J	22 J	23 J
1,4-Dioxane in ug/kg	119	130 U	180 U	160 U	140 U	140 U
2,3,4,6-Tetrachlorophenol in ug/kg	284	25 U	26 U	27 U	25 U	25 U
2,4,5-Trichlorophenol in ug/kg	819	25 U	26 U	27 U	25 U	25 U
2,4,6-Trichlorophenol in ug/kg	2,650	25 U	26 U	27 U	25 U	25 U
2,4-Dichlorophenol in ug/kg	117	25 U	26 U	27 U	25 U	25 U
2,4-Dimethylphenol in ug/kg	29	25 U	26 U	27 U	25 U	25 U
2,4-Dinitrophenol in ug/kg	6.21	120 UJ	130 U	130 UJ	120 UJ	120 UJ
2-Chloronaphthalene in ug/kg	417	25 U	26 U	27 U	25 U	25 U
2-Chlorophenol in ug/kg	344	25 U	26 U	27 U	25 U	25 U
2-Nitroaniline in ug/kg		50 UJ	51 U	53 U	49 U	50 U
2-Nitrophenol in ug/kg		25 U	26 U	27 U	25 U	25 U
3,3'-Dichlorobenzidine in ug/kg	2,060	25 U	26 U	27 U	25 U	25 U
3-Nitroaniline in ug/kg		50 UJ	51 U	53 U	49 U	50 U
4,6-Dinitro-2-methylphenol in ug/kg	104	50 U	51 U	53 U	49 U	50 U
4-Bromophenyl phenyl ether in ug/kg	1,230	25 U	26 U	27 U	25 U	25 U
4-Chloro-3-methylphenol in ug/kg	388	25 U	26 U	27 U	25 U	25 U
4-Chloroaniline in ug/kg	146	25 U	26 U	27 U	25 U	25 U
4-Chlorophenyl phenyl ether in ug/kg		25 U	26 U	27 U	25 U	25 U
4-Methylphenol in ug/kg	670	25 U	17 J	17 J	25 U	25 U
4-Nitroaniline in ug/kg		50 UJ	51 U	53 U	49 U	50 U
4-Nitrophenol in ug/kg	13.3	50 UJ	51 U	53 U	49 U	50 U
Acetophenone in ug/kg		25 U	26 U	27 U	25 U	25 U
Atrazine in ug/kg	6.62	25 U	26 U	27 U	25 U	25 U
Benzaldehyde in ug/kg		25 U	26 U	38	25 U	19 J
Benzidine in ug/kg		25 U	26 U	27 U	25 U	25 U
Benzyl butyl phthalate in ug/kg	63	25 U	26 U	27 U	25 U	25 U
Bis(2-chloro-1-methylethyl) ether in ug/kg		25 U	26 U	27 U	25 U	25 U
Bis(2-chloroethoxy)methane in ug/kg		25 U	26 U	27 U	25 U	25 U
Bis(2-chloroethyl) ether in ug/kg	3,520	25 U	26 U	27 U	25 U	25 U
Bis(2-ethylhexyl) phthalate in ug/kg	1,300	25 U	26 U	27 U	25 U	42
Caprolactam in ug/kg		25 U	26 U	27 U	25 U	25 U
Carbazole in ug/kg		110	100	110	69	25 U
Diethyl phthalate in ug/kg	200	25 U	26 U	27 U	25 U	25 U
Dimethyl phthalate in ug/kg	71	25 U	26 U	27 U	25 U	25 U
Di-n-butyl phthalate in ug/kg	1,400	25 U	26 U	27 U	25 U	25 U
Di-n-octyl phthalate in ug/kg	6,200	25 U	26 U	27 U	25 U	25 U
Hexachlorobenzene in ug/kg	22	25 U	26 U	27 U	25 U	25 U
Hexachlorobutadiene in ug/kg	11	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Hexachlorocyclopentadiene in ug/kg	139	62 UJ	64 U	67 UJ	61 UJ	62 UJ
Hexachloroethane in ug/kg	804	2.7 U	3.6 U	3.1 U	2.7 U	2.8 U
Isophorone in ug/kg	432	25 U	26 U	27 U	25 U	25 U
N-Nitrosodimethylamine in ug/kg		25 U	26 U	27 U	25 U	25 U
N-Nitroso-di-n-propylamine in ug/kg		25 U	26 U	27 U	25 U	25 U
N-Nitrosodiphenylamine in ug/kg	28	25 U	26 U	27 U	25 U	25 U
Pentachlorophenol in ug/kg	360	37	54	110	47	35 J
Phenol in ug/kg	420	25 U	26 U	27 UJ	25 U	25 U

Table F-3B

02/28/2017

Final RI/FS Work Plan - Sediment Quality Data

V:\080239 Bremerton Former MGP Site\Deliverables\RI FS Workplan\Final\Appendices\F Soil, Groundwater, Sediment Data\Single Files\Tables F-3A and F-3B - Sediments Page 2 of 3

Table F-3B - Sediment Quality Data - E+E 2008 Brownfields

Bremerton Gas Works Superfund Site

Bremerton, Washington

Chemical Name	Sediment Initial PRG	WN01 6/4/08 (0-6 ft)	WN02 6/4/08 (0-6 ft)	WN03 6/4/08 (0-6 ft)	WN04 6/4/08 (0-6 ft)	WN05 6/4/08 (0-6 ft)
Volatile Organic Compounds (VOC)						
1,1,1,2-Tetrachloroethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1,1-Trichloroethane in ug/kg	856	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1,2 - Trichlorotrifluoroethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1,2,2-Tetrachloroethane in ug/kg	202	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1,2-Trichloroethane in ug/kg	570	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1-Dichloroethane in ug/kg	0,575	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,1-Dichloroethene in ug/kg	2,780	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,2,3-Trichlorobenzene in ug/kg	858	6.6 U	9 U	7.8 U	6.8 U	7.1 U
1,2,3-Trichloropropane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,2,4-Trimethylbenzene in ug/kg		18 J	26 U	27 U	15 J	25 U
1,2-Dibromo-3-chloropropane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,2-Dibromoethane (EDB) in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,2-Dichloroethane (EDC) in ug/kg	260	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,2-Dichloropropane in ug/kg	333	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
1,3,5-Trimethylbenzene in ug/kg		25 U	26 U	27 U	21 J	25 U
2-Butanone in ug/kg	42.4	6.6 U	9 U	7.8 U	6.8 U	7.1 U
2-Hexanone in ug/kg	58.2	6.6 U	9 U	7.8 U	6.8 U	7.1 U
4-Methyl-2-pentanone in ug/kg	25.1	6.6 U	9 U	7.8 U	6.8 U	7.1 U
Acetone in ug/kg	9.9	6.6 U	9 U	28	6.8 U	7.1 U
Benzene in ug/kg	137	7.4	1.8 U	1.5 J	1.4 U	1.4 U
Bromochloromethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Bromodichloromethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Bromoform in ug/kg	1,310	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Bromomethane in ug/kg	1.37	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Carbon disulfide in ug/kg	0.851	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Carbon tetrachloride in ug/kg	7,240	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Chlorobenzene in ug/kg	162	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Chloroethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Chloroform in ug/kg	121	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Chloromethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
cis-1,2-Dichloroethene (DCE) in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
cis-1,3-Dichloropropene in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Cyclohexane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Dibromochloromethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Dichlorodifluoromethane in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Ethylbenzene in ug/kg	305	2.3	1.8 U	1.6 U	1.4 U	1.4 U
Isopropylbenzene in ug/kg	86	0.48 J	1.8 U	1.6 U	1.4 U	1.4 U
Methyl acetate in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Methyl tert-butyl ether (MTBE) in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Methylcyclohexane in ug/kg		0.65 J	1.8 U	1.6 U	1.4 U	1.4 U
Methylene chloride in ug/kg	159	1.3 UJ	1.8 J	1.6 UJ	1.4 UJ	1.4 UJ
Styrene in ug/kg	7,070	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Tetrachloroethene (PCE) in ug/kg	190	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Toluene in ug/kg	1,090	0.51 J	1.8 U	1.6 U	1.4 U	1.4 U
trans-1,2-Dichloroethene in ug/kg	1,050	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
trans-1,3-Dichloropropene in ug/kg		1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Trichloroethene (TCE) in ug/kg	8,950	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
Trichlorofluoromethane in ug/kg		1.3 UJ	1.8 UJ	1.6 UJ	1.4 UJ	1.4 UJ
Vinyl chloride in ug/kg	202	1.3 U	1.8 U	1.6 U	1.4 U	1.4 U
m,p-Xylenes in ug/kg		2.9	1.8 U	1.6 U	1.4 U	1.4 U
o-Xylene in ug/kg		5.7	1.8 U	1.6 U	1.4 U	1.4 U

Notes

Concentrations in shaded cells indicate value exceeds the Sediment PRG

J = Analyte was positively identified. The reported result is an estimate.

PRG = preliminary remediation goal

U = Analyte was not detected at or above the reported result.

Table F-3B

02/28/2017

Final RI/FS Work Plan - Sediment Quality Data

APPENDIX G

Upland Site Health and Safety Plan (Aspect Consulting, LLC)



PROJECT-SPECIFIC HEALTH AND SAFETY PLAN

Property Name:	Former Bremerton Gas Works Property		
Project Number:	080239		
Prepared By:	Robert Hanford	Date:	4/13/2015
Reviewed By:	Carla Brock	Date:	4/14/2015

1 INTRODUCTION

This project-specific health and safety plan establishes procedures and practices to protect employees of Aspect Consulting, LLC (Aspect) from potential hazards posed by field activities at the subject site. In this health and safety plan, measures are provided to minimize potential exposure, accidents, and physical injuries that may occur during daily activities and adverse conditions. Contingency arrangements are also provided for emergency situations.

2 EMERGENCY CONTACT INFORMATION

PROPERTY LOCATION	Former Bremerton Gas Works Property 1725 Pennsylvania Avenue Bremerton, WA 98337
NEAREST HOSPITAL	Harrison Medical Center 2520 Cherry Avenue Bremerton, WA 98310 360-377-3911 ATTACHED FIGURE SHOWS ROUTE TO HOSPITAL.
EMERGENCY RESPONDERS	Police, Ambulance, Fire 911
OTHER CONTACTS	Aspect, Bob Hanford (mobile)..... Aspect, Seattle Office(206) 328-7443 Cascade, Kalle Godel.....(701) 471-0297 EPA, William Ryan(206) 553-8561
IN EVENT OF EMERGENCY, CALL FOR HELP AS SOON AS POSSIBLE	Give the following information: <ul style="list-style-type: none">✓ Where You Are: address, cross streets, or landmarks✓ Phone Number you are calling from✓ What Happened: type of accident, injury✓ How Many Persons need help✓ What is Being Done for the victims✓ You Hang Up Last: let whomever you called hang up first

In case of serious injuries or other emergency, immediately call Bob Hanford, Aspect Corporate Safety Officer, at (206) 780-7729 or (206)-276-9256. If no response, call Doug Hillman at (206) 328-7443 or Tim Flynn at (206) 780-9370.

3 PERSONNEL ORGANIZATION AND CHAIN OF COMMAND

The Aspect Project Manager assigns the Site Safety Supervisor and other field personnel for this project, and has ultimate responsibility for developing this project-specific health and safety plan and ensuring it is complied with during project execution. The Aspect Site Safety Supervisor has responsibility and authority for Aspect employees' safety during site activities. Other Aspect personnel on site have the responsibility to comply with this project-specific health and safety plan in coordination with the Site Safety Supervisor.

Aspect Personnel			
Role	Name	Office Phone	Mobile/Cell Phone
Project Manager	Jeremy Porter	206-838-5835	(b) (6)
Project Geologist	Carla Brock	206-838-6593	
Site Safety Supervisor	Bob Hanford	206-780-7729	
Other Field Personnel	Amy Tice	206-838-6585	
Other Field Personnel	Aaron Pruitt	206-838-6587	
Other Field Personnel	Simon Butler	206-838-5843	
Aspect's Subcontractors Working On Site			
Name	Task/Role	Contact	Phone
Applied Professional Service	Private utility locate	Bill Phillips	206-571-1857
Holt Services	Drilling, well installation	Dale Smith	253-604-4878
Clearcreek Contractors	Test pits	Mark McCullough	360-659-2459

Aspect will inform its subcontractors working onsite of potential fire, explosion, health, safety or other hazards associated with planned site activities, and can make available to them this project-specific health and safety plan. **However, all subcontractors are solely responsible for preparation of their own health and safety plan, and for the safety of their employees.**

4 SITE CONTROL PLAN

4.1 Property Description

Property Name:	Former Bremerton Gas Works Property	
Property Location or Address:	1725 Pennsylvania Avenue, Bremerton, WA	
Owners/Tenants:	Paul McConkey, Natacha Sesko	
Current Property Use:	Misc. Equipment Storage/Vacant	
Past Use of Property (if different):	Manufactured gas plant (coal and oil), equipment and boat storage and maintenance facility	
Designated Hazardous Waste Site?	yes	Federal: Yes
Industrial Site?	yes	
Topography:	Gently sloping to the north with a steep 3V:1H slope to the shoreline	
Surround Land Use/Nearest Population:	Mixed commercial and residential	

Drinking Water/Sanitary Facilities:	None currently on site. There will be portable equipment available when site activities start.
Site Map:	Available in Remedial Investigation/Feasibility Study Work Plan

4.2 Site Access Control

Describe controls to be used to prevent entry by unauthorized persons:

- The property is closed to the public (fenced with secured gate).
- Traffic cones, barriers, chain-link fence, and caution tape, as needed.

Describe how exclusion zones and contamination reduction zones will be designated:

- Drilling and test pit activities will be performed in multiple areas of the property.
- The area immediately adjacent to each boring/monitoring well/test pit location will be considered an exclusion zone.
- The subcontractor will mark the limits of the exclusion zone using cones, caution tape, etc.
- The contamination reduction zone will be located adjacent to the driller's/excavation contractor's mobile decontamination trailer, and will include steam cleaning equipment for equipment decontamination.
- Aspect field personnel will remain vigilant about preventing unauthorized persons from approaching the exclusion zone.

4.3 Worker Hygiene Practices

Aspect personnel will use the following hygiene practices while working on site:

- No person will eat, drink, chew gum or tobacco in potentially contaminated areas. Drinking of replacement fluids for heat stress control will be permitted only in areas that are free from contamination, except in emergency situations.
- Smoking is prohibited except in designated areas of the site.
- Long hair will be secured away from the face so that it does not interfere with any activities.
- All personnel leaving potentially contaminated areas will wash their hands and face prior to entering any eating areas.
- Personnel leaving potentially contaminated areas will shower (including washing hair) and change to clean clothing as soon as practical after leaving the property.

4.4 Emergency Communications

Aspect workers on site will have a mobile (cell) phone on site, which will be used for communications should an emergency arise. Phone numbers for Aspect site personnel are listed in Section 3: Personnel Organization and Chain of Command.

4.5 Nearest Medical Assistance

FIRST CALL 911. The route from the site to the nearest hospital is shown in the attached figure.

5 SITE WORK PLAN

Proposed Work Activities On Site:	<ul style="list-style-type: none"> • Geophysical ground survey using EM and GPR technologies. • Direct push drilling exploration. • Hollow stem auger or sonic drilling, well installation and development. • Test pit exploration. • Groundwater sampling. • Slope reconnaissance and seep sampling.
Objectives of Site Activities:	Remedial investigation to describe the nature and extent of potential site contamination.
Proposed Work Dates:	August 2015 through June 2016
Will On-site Personnel Potentially be Exposed to Hazardous Substances?	<p>If yes, describe: The property historically included a manufactured gas plant. Surrounding facilities included two petroleum bulk plants with fuel unloading from marine ships and barges. Based on previous site investigations by others, potential chemical hazards include:</p> <ul style="list-style-type: none"> • Petroleum hydrocarbons including polycyclic aromatic hydrocarbons (PAHs) and aromatic volatile organic compounds; • Creosote; and • Heavy metals (arsenic, lead and chromium).
Do Personnel Conducting Site Activities have Training in Accordance with WAC 296-843-200?	Yes

6 DECONTAMINATION

Goals	Procedures
To prevent the distribution of contaminants outside the exclusion zone or cross-contamination of samples, the following procedures will be used to decontaminate sample equipment.	<ul style="list-style-type: none"> Decontamination process involving Alconox wash, tap water rinse, and deionized water rinse (with air dry). Hexane rinse may be used only to remove organic chemicals that cannot be removed efficiently with soap and water (e.g., petroleum product). Dedicated tubing used for groundwater sampling will be disposed of or retained (bagged) for future use, but not decontaminated.
To prevent the distribution of contaminants outside the exclusion zone, unnecessary vehicles will not be allowed inside the exclusion zone. For vehicles required in the exclusion zone (e.g., drill rig, excavator), the following decontamination procedures will be used to prevent contamination from leaving the exclusion zone:	<ul style="list-style-type: none"> Steam clean drilling equipment and excavator bucket that advances below ground surface.
To minimize or prevent worker exposure to hazardous substances, all personnel working in the exclusion zone and contamination reduction zones will comply with the following decontamination procedures:	<ul style="list-style-type: none"> Wash boots and rain gear that have come into contact with soil or groundwater with Alconox/tap water and air dry. Dispose of disposable personal protective equipment (PPE such as gloves, Tyvek) into Department of Transportation (DOT) approved and appropriately labeled 55-gallon drums. To prevent distribution of contaminants outside the exclusion zone, do not allow unnecessary vehicles inside the exclusion zone.
Soil cuttings, monitoring well purge water, and decontamination wastewater will be managed in the following manner:	<ul style="list-style-type: none"> Soil will be stored in DOT-approved 55-gallon drums (appropriately labeled) at the sample location for future disposal by Cascade Natural Gas Corporation. Combine decontamination wastewater and monitoring well purge water from locations with evidence of contamination in DOT-approved 55-gallon drums at the property for future disposal by Cascade Natural Gas Corporation.

7 HAZARD ANALYSIS

The potential hazards and corresponding control measures for planned site work activities are as follows:

Work Activity	Primary Potential Hazards	Control Measures
Geophysical survey	<ul style="list-style-type: none"> Slip, trips and falls 	<ul style="list-style-type: none"> Clear survey lines of vegetation and debris prior to survey.
Drilling borings/monitoring wells, soil sampling	<ul style="list-style-type: none"> Getting hit by drill rig equipment, especially from overhead. 	<ul style="list-style-type: none"> Stay back from rig whenever possible and stay alert. Modified Level D PPE (with hard hat, traffic vest, steel-toe boots).
	<ul style="list-style-type: none"> Excessive noise. 	<ul style="list-style-type: none"> Wear hearing protection.
	<ul style="list-style-type: none"> Chemical exposure (skin contact, ingestion, inhalation). 	<ul style="list-style-type: none"> Modified Level D PPE. Air monitoring.
Test pits, soil sampling	<ul style="list-style-type: none"> Getting hit by excavator. 	<ul style="list-style-type: none"> Wear traffic vest. Stay back from excavator and maintain eye contact with operator.
	<ul style="list-style-type: none"> Falling into open excavation. 	<ul style="list-style-type: none"> Do not enter excavation >4 feet deep unless properly shored or sloped. Stay back from unstable slopes. Sample from excavator bucket where needed.
	<ul style="list-style-type: none"> Chemical exposure (skin contact, ingestion, inhalation). 	<ul style="list-style-type: none"> Modified Level D PPE. Air monitoring.
Soil sampling by hand augers or surface grabs	<ul style="list-style-type: none"> Chemical exposure (skin contact, ingestion, inhalation). 	<ul style="list-style-type: none"> Modified Level D PPE. Air monitoring.
Well development and groundwater sampling	<ul style="list-style-type: none"> Chemical exposure (skin or eye contact, ingestion). 	<ul style="list-style-type: none"> Modified Level D PPE. Securely join pump tubing and other connectors.
All	<ul style="list-style-type: none"> Getting hit by other trucks working on the property. 	<ul style="list-style-type: none"> Wear traffic vest. Stay back from roads and stay alert.
	<ul style="list-style-type: none"> Steep slopes 	<ul style="list-style-type: none"> Use extreme caution and buddy system for slope reconnaissance. Improve access as need if monitoring stations are established.
	<ul style="list-style-type: none"> Heat stress and hypothermia 	<ul style="list-style-type: none"> Take breaks, seek shade, adjust schedule, and increase fluid intake. Dress appropriately for weather conditions

Potentially Hazardous Chemicals Known or Suspected at the Property and Permissible Exposure Limits (air)					
Substance	Medium	OHSA PEL	OSHA STEL	IDLH	Carcinogen or Other Hazard
Gasoline-Range Petroleum	Soil, GW	10 ppmv	15 ppmv	250 ppmv	T
Diesel- and Oil-Range Petroleum	Soil, GW	1 ppmv	5 ppmv	500 ppmv	T
cPAHS	Soil, GW	0.2 mg/m ³	--	--	C
Benzene	Soil, GW	1 ppmv	5 ppmv	500 ppmv	C
Toluene	Soil, GW	200 ppmv	--	500 ppmv	T
Ethylbenzene	Soil, GW	100 ppmv	--	800 ppmv	T
Xylenes	Soil, GW	100 ppmv	150 ppmv	900 ppmv	T
Heavy Metals (arsenic, lead, chromium, etc.)	Soil, GW	As: 0.01 mg/m ³ Pb: 0.05 mg/m ³ Cr: 0.5 mg/m ³	As: -- Pb: -- Cr: --	As: 0.01 mg/m ³ Pb: 0.05 mg/m ³ Cr: 0.5 mg/m ³	Arsenic: C

Notes:

-- = none established
 C = carcinogen
 cPAH = carcinogenic polycyclic aromatic hydrocarbon
 GW = groundwater
 IDLH = immediately dangerous to life or health
 N/A = not applicable/not available
 OHSA = Occupational Safety and Health Administration
 T = toxic
 PEL = permissible exposure level (8-hour time-weighted average)
 STEL = short-term exposure level

Chemicals Known or Suspected On-site (check box)			
Chemical Class	Known	Possible	Unlikely
Corrosive (if expected, specify)			x
Ignitable (if expected, specify)		x	
Reactive			x
Volatile		x	
Radioactive			x
Explosive			x
Biological Agent			x
Particulate or Fibers			x
If known or likely, describe:			

8 PERSONAL PROTECTIVE EQUIPMENT

Based on the hazards identified above, the following personal protective equipment (PPE) will be required for the following field activities. This section specifies both an initial level of protection and a more protective (contingency) level or protection, in the event conditions should change. The contingency defines the PPE that will be available on site.

Work Activity	Level of Protection	
	Initial	Contingency
Geophysical survey	D	N/A
Drilling/test pits/soil sampling	D	Mod. D or C
Well development/groundwater sampling	D	Mod. D or C
Sample handling	D	Mod. D or C
Other activities (list): Slope reconnaissance	D	Mod. D or C

Each level of protection will incorporate the following equipment (specify type of protective clothing, boots, gloves, respiratory cartridges or other protection, safety glasses, hardhat, and hearing protection):

Level of Protection	Specific PPE
Level D	Work clothing, traffic vest, rubber (nitrile) gloves, steel toe and shank boots, safety glasses, hearing protection, and hardhat.
Modified D	Level D plus Tyvek coveralls or rain gear, and neoprene outer gloves.
Level C	Level D plus air-purifying respirator with combination organic vapor/HEPA dust cartridges.

NOTE: Project personnel are not permitted to deviate from the specified levels of protection without the prior approval of the Site Safety Supervisor. A traffic vest is not needed if work clothes are suitably visible (e.g., orange/yellow rain gear or white/yellow chemical protective clothing).

9 AIR MONITORING

Air monitoring will be conducted for all subsurface explorations (soil borings, monitoring wells, and test pit excavations) to identify potentially hazardous environments and determine reference or background concentrations. Air monitoring can be used to define exclusion zones. Air monitoring can also be conducted to evaluate relative concentrations of volatile organic chemicals in samples.

The following equipment will be used to monitor air quality in the breathing zone during work activities:

Monitoring Instrument	Calibration Frequency	Parameters of Interest	Sampling Frequency
PID	Daily	Volatile organic compounds	<ul style="list-style-type: none"> During collection of each soil sample during drilling. During trenching.
Detector tube (<i>specify chemical</i>)	As required	Benzene	<ul style="list-style-type: none"> As needed based on PID monitoring

Use the following action levels to determine the appropriate level of personal protection to be used during field activities:

Monitoring Instrument	Reading in Breathing Zone	Action	Comments
PID	10 PID units above background for 5 minutes	Confirm with detector tube (<i>specify chemical</i>) or upgrade to Level C (air-purifying respirator with organic vapor cartridge).	Alternatively, use engineering controls (ventilation) or leave location and return at a later time.
Detector tube (<i>specify chemical</i>)	> PEL	Upgrade to Level C (air-purifying respirator with organic vapor cartridge).	Leave location pending further evaluation by Aspect Corporate Safety Officer.
PID	100 PID units above background for 5 minutes	Leave location pending further evaluation by Aspect Corporate Safety Officer.	

10 SAFETY EQUIPMENT

The following safety equipment will be on site during the proposed field activities:

Other Required Items (check items required)	
First aid kit	x
Eyewash (e.g., bottled water)	x
PID	x
Drinking water	x
Fire extinguisher	x
Brush fan	
Wind sox	x
Other:	

11 SPILL CONTAINMENT

Will the proposed field work include the handling of bulk chemicals?	Yes	No x
If yes, describe spill containment provisions for the property:		

12 CONFINED SPACE ENTRY

Will the proposed field work include confined space entry?	Yes	No x
If yes, attach to this plan the confined space entry checklist and permit.		

13 ASPECT TRAINING AND MEDICAL MONITORING

Aspect employees who perform site work are responsible for understanding potential health and safety hazards of the site. All Aspect site workers will have health and safety training for hazardous waste operations, in accordance with WAC 296-843-200. In addition, Aspect requires medical monitoring for all employees potentially exposed to chemical hazards in concentrations in excess of the permissible exposure limit (PEL) for more than 30 days per year, as required under WAC 296-843-210. Employees who use respirators for their work will have a respirator medical evaluation as required under Chapter 296-842-WAC.

14 DISCLAIMER

Aspect Consulting, LLC does not guarantee the health or safety of any person entering these property. Because of the potentially hazardous nature of this property and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at this property. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other property without prior evaluation by trained health and safety personnel.



FIELD SAFETY PLAN CONSENT AGREEMENT

Aspect Consulting Employees

I have reviewed the project specific health and safety plan, dated April 13, 2015 for the Former Bremerton Gas Works Project fieldwork. I understand the purpose of the plan and I consent to adhere to its procedures and guidelines while conducting activities on site that are described in the plan.

Employee Printed Name	Signature	Date

Site Visitors

I have been briefed on the contents of the project-specific health and safety plan. I am responsible for my own health and safety.

Visitor Printed Name and Organization/Company	Signature	Date

FIELD SAFETY MEETING MINUTES



Drive 2.3 miles, 6 min

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APPENDIX H

Marine Site Health and Safety Plan (Anchor QEA)

Marine Health and Safety Plan

Appendix B of the Draft RI/FS Work Plan

Bremerton Gas Works Site

Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01

May 19, 2017

Prepared by



Aspect Consulting, LLC
401 Second Avenue South, Suite 201
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Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

Marine Health and Safety Plan

Appendix B of the Draft RI/FS Work Plan

Bremerton Gas Works Site
Prepared for: Cascade Natural Gas Corporation

Aspect Project No. 080239-005 • Anchor QEA Project No. 131014-01.01
May 19, 2017

Aspect Consulting, LLC & Anchor QEA, LLC

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1 INTRODUCTION

Cascade Natural Gas Corporation (Cascade Natural Gas) is conducting a Remedial Investigation/Feasibility Study (RI/FS) at the Bremerton Gas Works Site (Site) in Bremerton, Washington. The work is being conducted under an Administrative Settlement Agreement and Order on Consent (AOC) with the U.S. Environmental Protection Agency (EPA), executed on May 1, 2013.

This Health and Safety Plan (HASP) is designed to protect Anchor QEA, LLC, personnel from physical, chemical, and other hazards posed by site investigation and field sampling efforts detailed at the Site. Field activities covered under this HASP include video surveys, surface and subsurface sediment sampling, surface water sampling and monitoring, beach shellfish surveys, and a tidal current evaluation.

2 SITE DESCRIPTION AND PROJECT SCOPE

The Site is located on the north shore of Dyes Inlet in Bremerton, Washington, between Thompson and Pennsylvania Avenues in West Bremerton. Land use in the Site area is currently industrial and light commercial. In 2010, a 12-inch concrete pipe in the intertidal area was observed to be the apparent source of product and intermittent sheens on surface water of Dyes Inlet. A time-critical removal action was conducted at the site to address the leaking pipe and placement of an organo-clay mat over the area in which sheens had been observed. A second time-critical removal action was conducted in 2013 to address migration pathways at the Site that pose a threat to human health, welfare, or the environment. This removal action included removing solid hydrocarbon from the Site and installing an organo-clay mat along the western portion of the beach, plugging Manhole A and a sump drain, and installing required signage.

The current project scope consists of video surveys, surface and subsurface sediment sampling, surface water sampling and monitoring, beach shellfish surveys, and a tidal current evaluation to understand regional trends in sediment and water quality that may affect either current Site conditions or result in future recontamination of the Site.

3 EMERGENCY RESPONSE PLAN

Because of the health and safety hazards associated with the field sampling and sample handling activities, the potential exists for an emergency to occur.

Emergencies may include personal injury, exposure to hazardous substances, fire, explosion, or release of toxic or non-toxic substances (spills). Occupational Safety and Health Administration (OSHA) regulations require that an emergency response plan be available for use onboard to guide actions in emergencies.

Onshore organizations will be relied upon to provide response in emergencies. The local fire department and ambulance service can provide timely response. Anchor QEA personnel and subcontractors will be responsible for identifying an emergency, providing first aid if applicable, notifying the appropriate personnel or agency, and evacuating any hazardous area. Sampling personnel will attempt to control only very minor hazards that could present an emergency, such as a small fire, and will otherwise rely on outside emergency response resources.

The following subsections address key safety personnel, authority and responsibilities of key personnel, and pre-emergency preparation; identify individual(s) who should be notified in case of emergency; provide a list of emergency telephone numbers; offer guidance for particular types of emergencies; and provide directions and a map for getting from the Site to a hospital.

3.1 Key Safety Personnel

The following people share responsibility for health and safety at the Site. The next section includes a description of the role and responsibility of each.

Project Manager: Mark Larsen	Office: 206-287-9130 Cell: (b) (6)
Field Coordinator: Nathan Soccorsy	Office: 206-287-9130 Cell:
Site Supervisor: Evan Malczyk	Office: 206-287-9130 Cell:
Site Safety and Health Officer: Nathan Soccorsy	Office: 206-287-9130 Cell:
Field Personnel: TBD	Cell: TBD

3.2 Authority and Responsibilities of Key Personnel

This section describes the authority and responsibilities of key Anchor QEA personnel. The names and contact information for the following key safety personnel are listed in the previous section of this HASP. Should key site personnel change during the course of the project, a new list will be established and posted immediately at the Site. The emergency phone number for the Site is **911** and should be used first for all medical, fire, and police emergencies.

3.2.1 Project Manager

The project manager (PM) provides overall direction for the project and is responsible for ensuring that the project meets the client's objectives in a safe and timely manner. The PM is responsible for providing qualified staff for the project and adequate resources and budget for the health and safety staff to carry out their responsibilities during the field work. The PM is in regular contact with the field coordinator (FC; see Section 3.2.2) and site safety and health officer (SSHO; see Section 3.2.3) to ensure that appropriate health and safety procedures are implemented into each project task. The PM has authority to direct response operations; the PM assumes total control over project activities but may assign responsibility for aspects of the project to others. In addition, the PM:

- Oversees the preparation and organization of background review of the project, the work plan, and the field team
- Ensures that the team obtains permission for site access and coordinates activities with appropriate officials
- Briefs the FC and field personnel on specific assignments
- Together with the FC, sees that health and safety requirements are met
- Consults with the SSHO regarding unsafe conditions, incidents, or changes in site conditions or the scope of work

3.2.2 Field Coordinator

The FC reports to the PM and has authority to direct response operations and assumes control over on-site activities. The FC will direct field activities, coordinate the technical and health and safety components of the field program, and is responsible in general for enforcing the HASP and Corporate HASP. The FC will be the primary

point of contact for all field personnel and visitors and has direct responsibility for implementation and administration of this HASP. The FC and any field personnel have the authority to stop or suspend work in the event of an emergency, if conditions arise that pose an unacceptable health and safety risk to the personnel or environment, or if conditions arise that warrant revision or amendment of this HASP. The functions of the FC related to this HASP include but are not necessarily limited to the following:

- Conduct and document daily safety meetings, or designate an alternate FC in his or her absence
- Execute the work plan and schedule
- Periodic field health and safety inspections to ensure compliance with this HASP
- Oversee implementation of safety procedures
- Implement worker protection levels
- Enforce site control measures to ensure that only authorized personnel are allowed on site
- Notify, when necessary, local public emergency officials (all personnel on site may conduct this task as needed)
- Follow-up on incident reports to the PM
- Periodically inspect protective clothing and equipment for adequacy and safety compliance
- See that protective clothing and equipment are properly stored and maintained
- Perform or oversee air monitoring in accordance with this HASP
- Maintain and oversee operation of monitoring equipment and interpretation of data from the monitoring equipment
- Monitor workers for signs of stress, including heat stress, cold exposure, and fatigue.
- Require participants to use the “buddy” system
- Provide (via implementation of this HASP) emergency procedures, evacuation routes, and telephone numbers of the local hospital, poison control center, fire department, and police department
- Communicate incidents promptly to the PM
- Maintain communication with the SSHO on site activities
- If applicable, ensure decontamination and disposal procedures are followed
- Maintain the availability of required safety equipment

-
- Advise appropriate health services and medical personnel of potential exposures.
 - Notify emergency response personnel in the event of an emergency. Coordinate emergency medical care

The FC will record health-and-safety-related details of the project in the field logbook. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all on-site personnel
- Level of personal protective equipment (PPE) worn and any other specifics regarding PPE
- Weather conditions
- Type of field work being performed

The FC will have completed the required OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and annual updates, the 8-hour Supervisor training, current first aid and cardiopulmonary resuscitation (CPR) training, and medical monitoring clearance, if applicable. Other certifications or training may be stipulated based on client or site requirements.

3.2.3 Site Safety and Health Officer

Anchor QEA's SSHO will be responsible for managing on-site health and safety activities and will provide support to the PM and FC on health and safety issues. The specific duties of the SSHO are to:

- Provide technical input into the design and implementation of this HASP.
- Advise on the potential for occupational exposure to project hazards, along with appropriate methods and/or controls to eliminate site hazards.
- Ensure that a hazard assessment has been performed and that the adequacy of the PPE selected was evaluated as required by 29 CFR 1910.132(d), 1910.134, 1926.25, and 1926.55, and is duly noted by the signatures and date appearing on the Certification Page of this document.
- Consult with the FC on matters relating to suspending site activities in the event of an emergency.
- Verify that all on-site Anchor QEA personnel and subcontractors have read and signed the HASP Acknowledgement Form.

-
- Review daily the on-site health and safety activities for effectiveness and modify as needed.
 - Verify that corrective actions resulting from deficiencies identified by daily health and safety reviews and observations are implemented and effective.

The SSHO will have completed the required OSHA 40-hour HAZWOPER training and annual updates, the 8-hour Supervisor training, and have medical monitoring clearance, if applicable. In addition, the SSHO will have current training in first aid and CPR.

3.2.4 Field Personnel

All project field personnel will attend a project-specific meeting conducted by the FC concerning safety issues and project work task review before beginning work. All field personnel must be familiar with and comply with this HASP. Subcontractors will be responsible for developing and complying with their own company HASP. The field personnel have the responsibility to immediately report any potentially unsafe or hazardous conditions to the FC. All members of the field personnel have the authority to stop or suspend work if conditions arise that pose an unacceptable health and safety risk to the field personnel or environment or if conditions arise that warrant revision or amendment of this HASP.

The field team reports to the FC for on-site activities and is responsible for

- Reviewing and maintaining a working knowledge of this HASP
- Safe completion of on-site tasks required to fulfill the work plan
- Compliance with the HASP
- Attendance and participation in daily safety meetings
- Notification to the FC of existing or potential safety conditions at the site
- Reporting all incidents to the FC
- Demonstrating safety and health conscious conduct

3.3 Pre-Emergency Preparation

Before the start of field activities, the FC will ensure that preparation has been made in anticipation of emergencies. Preparatory actions include the following:

-
- All field personnel meeting with the FC concerning the emergency procedures in the event that a person is injured. Appropriate actions for specific scenarios will be reviewed. These scenarios will be discussed and responses determined before the sampling event commences.
 - A training session given by the FC informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.
 - A training session given by senior staff operating field equipment, to apprise field personnel of operating procedures and specific risks associated with that equipment.
 - Ensuring that field personnel are aware of the existence of the emergency response plan, its location, and ensuring that a copy of the HASP accompanies the field team(s).

3.4 Project Emergency Coordinator

The FC will serve as the project emergency coordinator (PEC) in the event of an emergency. The FC will designate a replacement for times when he is not onboard or is not serving as the PEC. The designation will be noted in the logbook. The PEC will be notified immediately when an emergency is recognized. The PEC will be responsible for evaluating the emergency, notifying the appropriate emergency response units, coordinating access with those units, and directing interim actions onboard before the arrival of emergency response units. The PEC will notify the SSHO and the PM as soon as possible after initiating an emergency response action. The PM will have responsibility for notifying the client.

3.5 Emergency Response Contacts

All personnel must know whom to notify in the event of an emergency, even though the FC has primary responsibility for notification. Table 1 lists the names and phone numbers for emergency response services and individuals.

Table 1
Emergency Response Contacts

Emergency Phone Numbers		
Ambulance	911	
Fire	911	
Police	911	
Poison Control	1-800-222-1212	
Project Manager	Mark Larsen	Office: 206-287-9130 Cell: (b) (6)
Field Coordinator	Nathan Soccorsy	Office: 206-287-9130 Cell:
Site Safety and Health Officer	Nathan Soccorsy	Office: 206-287-9130 Cell:
National Response Center	1-800-424-8802	
State Emergency Response System	911	
EPA Environmental Response Team	1-201-321-6600	

Notes:

In the event of any emergency, the PM, FC, SSHO, or any field personnel may contact emergency responders listed in this table.

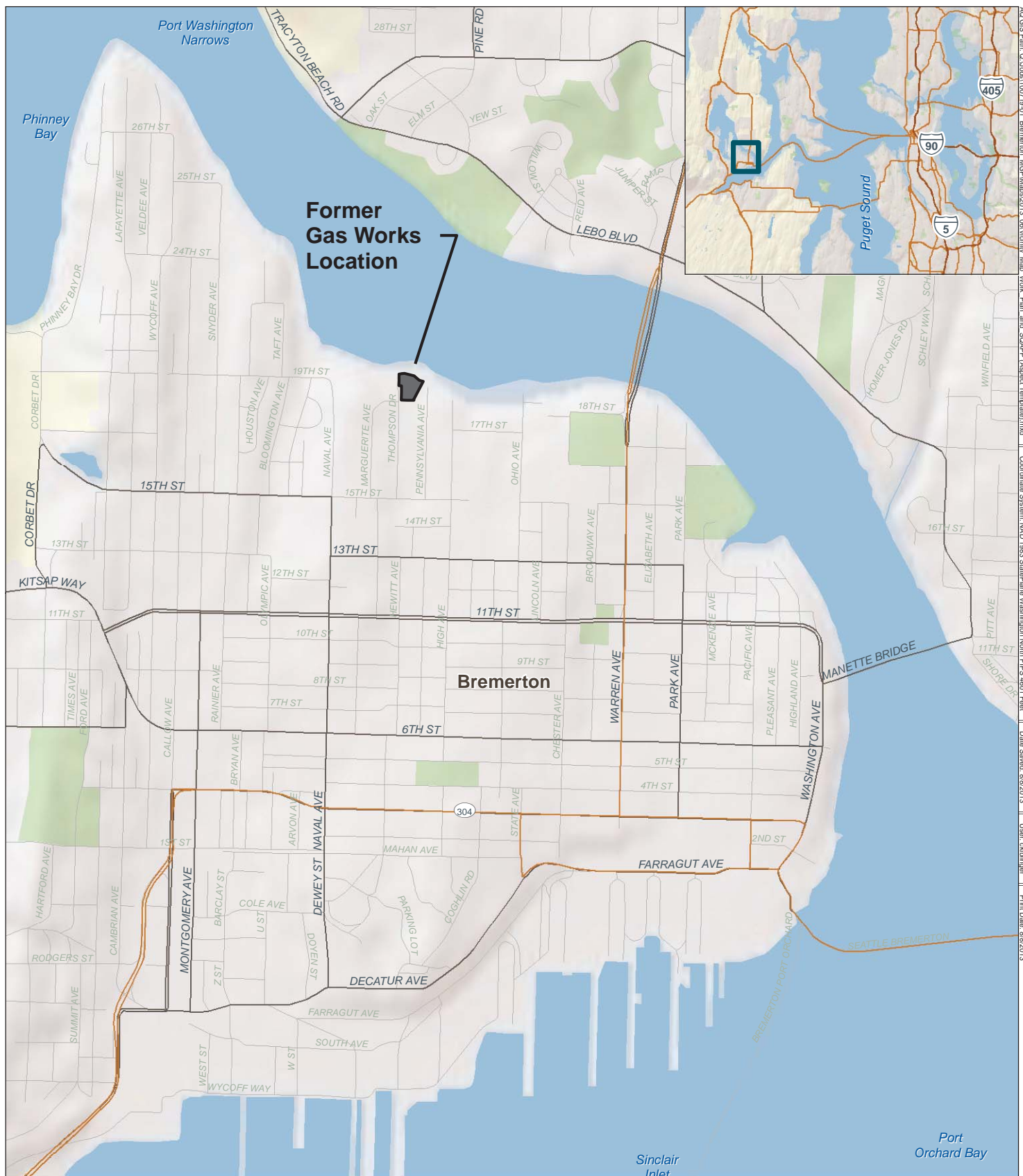
3.6 Emergency Response and Alerting Procedures

Each field team will carry a cell phone and an air horn that are in good working order. Cell phone coverage is good at the Site. Site communications will be done with either a cell phone or the air horn. If there is any type of emergency that requires Site evacuation (for example, a severe thunderstorm), the FC or any other site personnel recognizing the condition will blow the air horn three times. When the horn sounds, all personnel will meet at the end of Pennsylvania Avenue (Figure 1). All other emergency notifications that do not require evacuation will be conducted using a cell phone. Emergency phone numbers are listed in Table 1.

In the event of an emergency, immediate action must be taken by the first person to recognize the event. The following steps will be used as a guideline:

- Survey the situation to ensure that it is safe for you and the victim. Do not endanger your own life. Do not enter an area to rescue someone who has been overcome unless properly equipped and trained. Ensure that all protocols are followed. If applicable, review Material Safety Data Sheets (MSDS) to evaluate response actions for chemical exposures.

-
- Call the appropriate emergency number (**911**) or direct someone else to do this immediately (see Section 3.1). Explain the physical injury, chemical exposure, fire, or release and location of the incident.
 - Have someone retrieve the nearest first aid kit.
 - Decontaminate the victim without delaying life-saving procedures (see Section 3.8).
 - Administer first aid and CPR, if properly trained, until emergency responders arrive.
 - Notify the PM and the FC.
 - Complete the appropriate incident investigation reports.



3.7 Recognition and Prevention of Emergency Situations

Everyone on-site is responsible to monitor the environment for conditions that could lead to a release or an injury. Emergencies will generally be recognizable by observation. The Site team must take steps needed to respond to such observations. An injury or illness will be considered an emergency if it requires treatment by a medical professional and cannot be treated with simple first-aid techniques.

3.8 Decontamination

In the case of evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. If an injured individual is also heavily contaminated and must be transported by emergency vehicle, the emergency response team will be told of the type of contamination. To the extent possible, contaminated PPE will be removed, but only if doing so does not exacerbate the injury. Plastic sheeting will be used to reduce the potential for spreading contamination to the inside of the emergency vehicle.

3.9 Fire

Personnel will attempt to control only small fires, should they occur. If an explosion appears likely, personnel will follow evacuation procedures specified by the FC in the training session. If a fire cannot be controlled with a fire extinguisher that is part of the required safety equipment, personnel will either withdraw from the vicinity of the fire or use additional firefighting equipment, or evacuate the upland area as specified by the FC in the training session.

3.10 Personal Injury

In the event of serious personal injury, including unconsciousness, possibility of broken bones, severe bleeding or blood loss, burns, shock, or trauma, the first responder will immediately do the following:

- Administer first aid, if qualified.
- If not qualified, seek out an individual who is qualified to administer first aid, if time and conditions permit.

-
- Notify the PEC of the incident, the name of the individual, the location, and the nature of the injury.

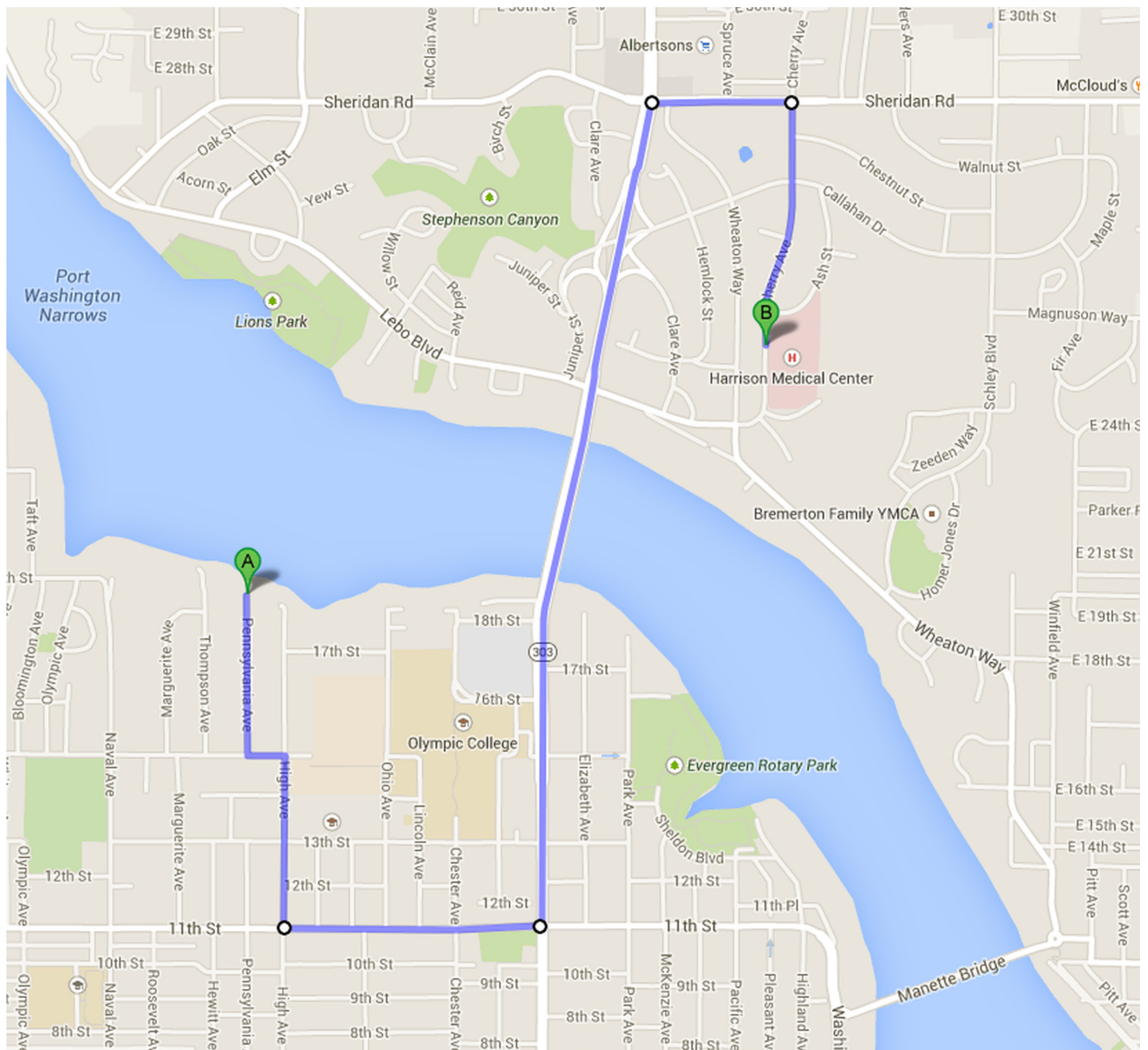
The PEC will immediately do the following:

- Notify the appropriate emergency response organization.
- Assist the injured individual.
- Follow the emergency procedures for retrieving or disposing equipment reviewed in the training session, and leave the Site en route to the predetermined land-based emergency pick-up.
- Designate someone to accompany the injured individual to the hospital.
- If an emergency (for example, broken bones or injury where death is imminent without immediate treatment) occurs, the FC will call 911 and arrange to meet the response unit at the nearest accessible dock.
- Notify the SSHO and the PM.

If the PEC determines that emergency response is not necessary, he may direct someone to decontaminate and transport the individual by vehicle to the nearest hospital. Directions and a map showing the route to the hospital are on Figure 2.

If a worker leaves the Site to seek medical attention, another worker should accompany him or her to the hospital. When in doubt about the severity of an injury or exposure, always seek medical attention as a conservative approach and notify the PEC.

The PEC will have responsibility for completing all accident/incident field reports, OSHA form 200s, and other required follow-up forms.



Directions from Site (A) to hospital (B):

1. Head south on Pennsylvania Ave toward 15th Street.
2. Turn left at 15th Street.
3. Take the first right onto High Avenue.
4. Take the third left onto 11th Street.
5. Turn left at Warren Avenue.
6. Continue onto Warren Avenue Bridge.
7. Turn right at Sheridan Road.
8. Take the second right onto Cherry Avenue. Destination will be on the left.

Harrison Bremerton Medical Center
 2520 Cherry Avenue
 Bremerton, WA 98310
 360-744-3911

Map to the Nearest Hospital

Health and Safety Plan
 Former Bremerton MGP Site



FIRM:
 ANCHOR QEA
 DRAWN BY:
 ckiblinger

FIGURE NO.
2

3.11 Overt Personal Exposure or Injury

If an overt exposure to toxic materials occurs, the first responder to the victim will initiate actions to address the situation. The following actions should be taken, depending on the type of exposure:

- Skin Contact:
 - Wash/rinse the affected area thoroughly with copious amounts of soap and water.
 - If eye contact has occurred, eyes should be rinsed for at least 15 minutes using the eyewash that is part of the emergency equipment onboard and in the lab.
 - After initial response actions have been taken, seek appropriate medical attention.
- Inhalation:
 - Move victim to fresh air.
 - Seek appropriate medical attention.
- Ingestion:
 - Seek appropriate medical attention.
 - Puncture Wound or Laceration:
 - Seek appropriate medical attention.

3.12 Spills and Spill Containment

As necessary, spill control measures will be used to contain contaminated materials that may enter into clean areas. Plastic sheeting, sorbent pads, sorbent booms, or a spill control system will be used to prevent spills and contain contaminated material. If a spill occurs, the SSHO will immediately discuss the event with the U.S. Coast Guard (USCG), EPA, or their oversight contractor to evaluate the need for reporting. Any spill will be reported consistent with state and federal law. In the case of a reportable spill, the National Response Center (800-424-8802) and the Washington State Emergency Response System (911) will be notified by the SSHO or the PM.

4 HAZARD EVALUATION AND CONTROL MEASURES

This section covers potential chemical and physical hazards that may be associated with the proposed field activities and presents control measures to address these potential hazards. Section 4.4 presents the activity hazard analysis, which lists the potential hazards associated with each site activity and the recommended site control to be used to minimize each potential hazard.

4.1 Exposure Routes

Potential routes of exposure to chemicals include inhalation, dermal contact, and ingestion of dust, mist, gas, vapor, or liquid. Exposure will be minimized by using safe work practices and by wearing the appropriate PPE. Further discussion of PPE requirements is presented in Section 7.

4.1.1 Inhalation

Inhalation of particulates, dust, mist, gas, or vapor during the planned activities is possible. Whenever possible, the work activity will be oriented so that personnel are upwind of the location. An organic vapor monitor (OVM), a photoionization detector (PID), or flame ionization detector (FID) will be used to monitor ambient air in the breathing zone within the work area for organic compounds. Table 2 describes air monitoring action levels and response procedures. A daily air monitoring log form is presented in Attachment 1.

Table 2
Air Monitoring Action Levels

Instrument	Job Tasks/Functions	Measurement	Monitoring Schedule ¹	Actions ²
OVM, FID, and/or PID (11.7*eV lamp) - Measures Total Organic Vapors	Conduct continuous air monitoring for volatile organic compounds during activities where contaminated media are present. Make sure that a background reading is taken before the start up of activities and periodically thereafter.	Sustained (for 2 minutes) 0 to 5 ppm above background in breathing zone	Continuous (logging periodically every 15 to 30 minutes)	Continue work
		Sustained (for 2 minutes) greater than 5 ppm above background	Continuous (logging periodically every 15 minutes)	Stop work if sustained readings for longer than 2 minutes. ³ Institute engineering controls. If concentrations decrease to below 1 ppm above background, continue work. If concentrations above 5 ppm persist, stop work and contact the project manager (PM) for further instructions.

Notes:

ppm parts per million

Instruments must be calibrated according to manufacturer's recommendations.

1 Monitoring frequency is at beginning of each task and continuously thereafter (logging periodically every 15 minutes), or when detectable sediment contamination is encountered (as indicated by strong, sustained odor, visual evidence of product or petroleum discolored soils). Air monitoring frequency may be changed based on obtained air data for a work task.

2 For VOCs, sustained reading for greater than 2 minutes in excess of the action level will trigger a protective measure.

3 Contact with the PM must be made prior to continuing work. A hazard review must be conducted before proceeding with work.

4.1.2 Dermal Contact

Dermal contact with potentially contaminated soil, sediment, or water operations is possible. Direct contact will be minimized by using appropriate PPE and decontamination procedures.

4.1.3 Ingestion

Ingestion of contaminants is a less likely route of exposure than inhalation or dermal contact for many of the contaminants of concern. Direct ingestion of contaminants can occur by inhaling airborne dust, mist, or vapors or swallowing contaminants trapped in the upper respiratory tract. Indirect ingestion can occur by introducing the contaminants into the mouth by way of food, tobacco, fingers, or other carriers. Although ingestion of contaminants can occur, proper decontamination/contamination reduction procedures should eliminate the probability of this route of exposure.

4.2 Chemical Hazards

Metals, volatile organic compounds (VOCs), petroleum hydrocarbons, PAHs, and free product (that is, coal tar) typically sourced from MGP activities may be present in sediments at the Site. In addition, there is some potential for exposure to hexane, acetone, or non-phosphate soap (that is, Alconox), which in some cases may be used as a decontamination materials. MSDSs for potential chemical hazards are included in Attachment 2.

4.2.1 Volatile Organic Compounds

Based on previous experience at MGP sites, VOCs possibly present at the Site include volatile components of gasoline [benzene, toluene, ethylbenzene, and xylenes (BTEX)]. The primary exposure routes for VOCs during the planned activities are inhalation, dermal contact, and ingestion of contaminated soil, sediment, dust, or water. VOCs readily volatilize and are primarily an inhalation concern. BTEX compounds are known or suspected human carcinogens. MSDSs for BTEX are included in Attachment 2.

An OVM will be used to monitor ambient air and the breathing zone for VOCs. Respiratory protection will be employed if elevated levels of organic compounds are measured by the OVM, if odors are present, or other conditions warrant its use. Air monitoring action levels are presented in Table 2.

4.2.2 Metals

The primary exposure routes for metals potentially during the planned activities are inhalation or ingestion of dust particles. Metals may also be indirectly ingested, as described in Section 4.1.3. A secondary route of exposure to metals is dermal contact. The target organs primarily affected by prolonged exposure to metals are the respiratory tract, gastrointestinal tract, central nervous system, kidneys, and liver. Prolonged exposure to metals through any of the potential routes of exposure is not expected. Skin will be washed immediately when exposed to soil, sediment, dust, or water potentially impacted by metals.

4.2.3 Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPHs) possibly at the Site include tar and oil related materials in sediments and soils, which contain benzene and aromatic hydrocarbons. Gasoline, diesel, fuel, and waste oil, and heavier hydrocarbons such as grease may also be present associated with sampling equipment. The primary exposure routes for petroleum hydrocarbons during the planned activities are inhalation, dermal contact, and ingestion of contaminated soil, sediment, dust, or water. Lighter petroleum hydrocarbons such as gasoline and benzene readily volatilize and are primarily an inhalation concern (as described in Section 4.2.1), whereas the primary route of exposure to heavier petroleum hydrocarbons such as aromatic hydrocarbons, oil, and grease is dermal contact. The target organs primarily affected by prolonged exposure to petroleum hydrocarbons are the respiratory system, central nervous system, kidneys, liver, and skin. Prolonged dermal contact with petroleum hydrocarbons can cause irritation or dermatitis. MSDSs for TPH are included in Attachment 2. As described in Section 4.2.1, an OVM will be used to monitor ambient air and the breathing zone for TPH compounds that have volatilized. Respiratory protection will be employed if elevated levels of organic compounds are measured by the OVM, if

odors are present, or other conditions warrant its use. Air monitoring action levels are presented in Table 2.

Petroleum hydrocarbons such as gasoline are also flammable and can be a physical hazard when present in high concentrations. Physical hazards associated with flammable compounds are addressed in Section 4.3.10. Combustion of petroleum hydrocarbons can produce carbon dioxide, carbon monoxide, aldehydes, fumes, smoke (particulate matter), and other products of incomplete combustion.

Intentional and inadvertent combustion of petroleum hydrocarbons is not expected during sampling activities; however, personnel will be removed from the area should a fire occur.

4.2.4 Polycyclic Aromatic Hydrocarbons

PAHs are petroleum hydrocarbons which are relatively nonvolatile due to their complex molecular structure and high molecular weight. Consequently, the primary route of exposure to PAHs is through dermal contact. PAHs may also be indirectly ingested, as described in Section 4.1.3. Inhalation of PAHs is unlikely due to their nonvolatile nature. Dermal or eye contact with PAHs can cause irritation or burning. MSDSs for PAHs are included in Attachment 2.

4.2.5 Hydrogen Sulfide

Hydrogen sulfide is a naturally occurring gas often associated with organic clay and peat. Hydrogen sulfide gas is potentially toxic through inhalation, ingestion, and contact with the skin and eyes. Inhalation can result in respiratory irritation, rhinitis, and edema of the lungs. Inhalation of hydrogen sulfide gas can result in headache, dizziness, and agitation. Acute exposure at high concentrations may result in coma and death because of respiratory failure. Hydrogen sulfide gas has a distinct rotten egg odor and, although not expected, will be noted if encountered in the field. MSDSs for hydrogen sulfide are included in Attachment 2.

4.3 Physical Hazards

4.3.1 *Slips, Trips, and Falls*

As with all fieldwork sites, personnel should exercise caution to prevent slips on slick surfaces. In particular, sampling near or conducting construction observation activities around excavations require careful attention to minimize the risk of falling down. The same care should be used in rainy conditions. Wearing boots with good tread, made of material that does not become overly slippery when wet, can minimize slips.

Trips are always a hazard on uneven surfaces or in a cluttered work area. Personnel will keep work areas as free as possible from items that interfere with walking and movement. See Section 4.3.5 for more details on uneven surfaces.

Falls may be avoided by working as far away from exposed edges as possible. For this project, the potential for falling is associated primarily with sediment sampling activities and construction management. Personnel will keep walkways and work areas clear when possible and use caution when walking along the shoreline and the riverbank slope.

4.3.2 *Fatigue*

Since personnel may be working during both daytime and nighttime hours (depending on the activity) 5 to 7 days a week, it is important that all personnel are aware of the hazards related to fatigue. Fatigue can occur at any time when working and may cause safety concerns due to decreased manual dexterity, reaction time, and alertness. The following section is provided to help, prevent, detect, and address fatigue-related issues.

Fatigue can be defined as an increasing difficulty in performing physical or mental activities. Signs of fatigue may include tiredness, changes in behavior, loss of energy, and the reduced ability to concentrate. Fatigued workers may have a reduced ability to recognize or avoid risks on the work site, which may lead to an increase in the number and severity of injuries and other incidents.

Fatigue results from insufficient rest and sleep between activities. Contributing factors to fatigue may include:

- The time of day that work takes place

-
- The length of time spent at work and in work-related duties
 - The type and duration of a work task and the environment (such as, weather conditions and ambient noise) in which it is performed
 - The quantity and quality of rest obtained prior to, during, and after a work period
 - Non-work activities
 - Individual factors such as sleeping disorders, medications, or emotional state

Personnel suffering from fatigue may exhibit both physical and mental effects, such as:

- Slower movements
- Poor coordination
- Slower response time to interaction
- Bloodshot eyes
- Slumped or weary appearance
- Nodding off
- Distractedness or poor concentration
- Inability to complete tasks
- Fixed gaze
- Appearing depressed, irritable, frustrated, or disinterested

Fatigue may cause an increased risk of incidents due to tiredness and lack of alertness. When workers are fatigued, they may be more likely to exercise poor judgment and have slower reactions to external and internal stimuli. This may increase all risks on site because fatigued workers may be less able or likely to respond effectively to changing circumstances, leading to an increased likelihood of incidents due to human error.

To stress the importance of managing fatigue, this topic will be covered in pre-work meetings and will include a discussion of what fatigue is, why it is hazardous, signs and symptoms, and ways to control or mitigate it. Employees will be strongly encouraged to get sufficient pre-work rest, to maintain sufficient nutritional intake during work (that is, eat and drink at regular intervals), and to communicate with team members and leaders if their level of fatigue elevates.

Fatigue management can usually be assisted through the performance of a routine exercise program and an established regular sleep schedule. Workers will be

informed that the occurrence of a good night's sleep can be enhanced by avoiding heavy meals or caffeine and minimizing or eliminating the consumption of alcohol and nicotine.

Workers will be periodically observed and directly queried for signs or symptoms of fatigue. Workers that express concern over their level of fatigue, or are observed to be fatigued such that elevated worker risk is evident, will be relieved or their work tasks adjusted so that they may rest sufficiently.

Consistent with applicable labor laws, individuals will not be scheduled to work more than 16 hours (including travel time) in any 24-hour period. Work schedules will consider fatigue factors and optimize continuous periods available for uninterrupted sleep. The employee is responsible for reporting to work properly rested and fit for duty. All personnel will be scheduled to receive a minimum of 8 hours of rest (that is, no work-related tasks) in any 24-hour period. In case of an emergency or operational difficulties (for example, access due to water levels), work hours may require adjustment, with worker consent.

4.3.3 Marine Sampling Equipment

Marine sampling will include the following equipment:

- Towed-camera video surveys
- Surface sediment sampling using a hydraulic Van Veen grab sampler
- Subsurface sediment sampling using a vibrocore
- Water sampling using a Van Dorn, or equivalent, sampler
- In situ water quality monitoring using a multi-parameter sonde
- Shellfish sampling conducted on beaches using hand tools
- Tidal currents evaluation using acoustic doppler

Prior to initiation of sampling, there will be a training session for all field personnel pertaining to the equipment that will be used.

4.3.4 Precautions When Working Around Heavy Equipment

The following precautions will be taken to minimize heavy equipment hazards:

- All equipment must have back-up alarms.
- Personnel must make eye contact with the operator before approaching the equipment and remain safely outside the swing radius of the equipment.

-
- Personnel must wear orange visibility vests in addition to standard Level D or modified Level D PPE.
 - Personnel must never stand on track-hoe tracks to communicate with the operator.
 - Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
 - Operators must wear hard hats when operating machines and when going to and from their equipment.
 - Operators must use spotters and be cautious when maneuvering equipment within 15 feet of overhead power lines and utility pole guy wires, and maintain safe distances at all times (greater than 10 feet).
 - Provisions will be made to prevent the unauthorized start-up of equipment when personnel leave the Site at the end of the shift, such as battery ignition locks.

4.3.5 Uneven Work Surfaces

Slips and trips on uneven surfaces such as an excavation edge or beach slope can be particularly hazardous. Care will be taken when setting up equipment near excavations or along the shore to provide an area for field personnel working on or near the equipment. Wearing boots with good tread that are made of material that does not become overly slippery when wet can minimize slips. Sturdy work gloves shall be worn to protect the hands against sharp or rough rocky surfaces.

4.3.6 Manual Lifting and Material Handling

Equipment and samples must be lifted and carried along the shoreline. Back strain can result if lifting is done improperly. During any manual handling tasks, personnel should lift with the load supported by their legs and not their backs. For heavy loads, an adequate number of people will be used, or if possible, a mechanical lifting/handling device. Leather gloves will be worn when handling metal, wire rope, sharp debris, or transporting material (for example, wood, piping, or drums).

4.3.7 Heat Stress

Scheduled sampling operations will be occurring in late fall, and the potential for high temperatures exists. The potential for heat stress may occur if impermeable PPE is worn or if strenuous work is performed under hot conditions with inadequate

water. When the core body temperature rises above 100.4 degrees Fahrenheit (° F), the body cannot sweat to cool down, and heat stress can occur. Heat stress may be identified by the following symptoms: dizziness, profuse sweating, skin color change, vision problems, confusion, nausea, fatigue, fainting, and clammy skin. Personnel exhibiting such symptoms will be removed to a cool shady area, given water, and allowed to rest. Fresh drinking water will be provided during field activities. All field team members will monitor their own condition and that of their co-workers to detect signs of heat stress.

4.3.8 Hypothermia

Since work will be conducted in the late fall, cold temperatures and hypothermia are also a possibility. Hypothermia is abnormal lowering of the core body temperature caused by exposure to a cold environment. Wind chill as well as wetness or water immersion can play a significant role. Typical signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. Confusion is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink.

Body temperatures below 90° F require immediate treatment to restore the temperature to normal. Current medical practice recommends slow warming of the individual followed by professional medical care. Moving the person to a sheltered area and wrapping them in a blanket can accomplish this portion of the task. If possible, the person should be placed in a warm room. In emergencies where body temperature falls below 90° F and shelter is not available, a sleeping bag, blankets, and body heat from another individual can be used to help raise body temperature.

4.3.9 Weather

In general, field team members will be equipped for the normal range of weather conditions. The designated FC will be aware of current weather conditions and of the potential for those conditions to pose a hazard to the field personnel. Some conditions that might force work stoppage are electrical storms, high winds, or high waves resulting from winds.

4.3.10 Flammable Hazards

Petroleum hydrocarbons are flammable in moderate to high concentrations; therefore, smoking, open flames, and unprotected ignition sources will not be allowed in the work area. An OVM will be used to measure concentrations of organic vapors in the work area. If elevated OVM measurements persist, work will be suspended until corrective measures are taken to ensure a safe work environment. Table 2 includes additional information about air monitoring action levels.

4.3.11 Biological Hazards

Direct contact with Dyes Inlet water may be hazardous due to the potential for combined sewer overflow (CSO) contamination. All field personnel will avoid contact with potential biological or infectious materials, wear PPE as appropriate, and wash hands and face as soon as possible after contact and before eating or drinking.

4.4 Job Safety Analysis

The job safety analysis (JSA) summarizes the field activities, outlines the hazards associated with each activity, and presents controls that can reduce or eliminate the risk of the hazard occurring. Details regarding specific hazards associated with marine sampling are provided in Attachment 3. The following JSAs are included:

- Boating Activities
- Sediment Sampling
- Water Sampling
- Beach Sampling
- Motor Vehicle Operation

5 WORK ZONES AND ACCESS CONTROL

The FC will delineate the boundaries of the work zones and will inform the field personnel of the arrangement. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas by defining work zone boundaries.

5.1 Sampling Work Zones

The following zones are sampling work zones:

- **Exclusion zone:** The exclusion zone will enclose the entire perimeter of the sampling location/machinery and will include the area where sampling is taking place. The exclusion zone will encompass an area 1.5-times the height of the drill rig tower around the drill rig where practical. Where topography and structures preclude this area, adjustments will be made in the field. Only sampling personnel may enter this zone unless assistance is required by other personnel. The exclusion zone will also include a nearby sample processing area along the shoreline or on top of the bank area. Samples will likely be processed under fold-up canopies and the exclusion zone will encompass the entire area under the canopy where samples will be processed or where contact to contaminated soil and sediments is possible. Entry and exit to this zone will be through a designated access point.
- **Contamination reduction zone (CRZ):** The CRZ during sediment handling will encompass the area surrounding the Exclusion zone. Decontamination of both personnel and equipment will occur in this zone to prevent the transfer of chemicals of concern to the support zone. Entry and exit between zones will be through a designated access point.
- **Support zone:** The support zone will be located in the on-site trailer or outside the CRZ.

Sampling staff will instruct people to stay outside the exclusion zone where samples are collected and where sample processing is occurring.

5.2 Decontamination Area

All contaminated materials will be properly contained. A station within the CRZ will be set up for decontaminating sample processing equipment and personnel gear such as boots or PPE. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to perform decontamination operations. Plastic bags will be

provided for expendable and disposable materials. The decontamination fluids will be stored in sealable containers and will be disposed of in accordance with applicable regulations.

5.3 Access Control

Security and control of access to the Site will be the responsibility of the site supervisor (SS) and/or SSHO. Access to the work areas will only be granted to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

6 SAFE WORK PRACTICES

Following common sense rules will minimize the risk of exposure or accidents at a work site. These general safety rules will be followed on site:

- Always use the buddy system.
- Be aware of overhead and underfoot hazards at all times.
- Do not eat, drink, smoke, or perform other hand-to-mouth transfers in the work zones.
- Get immediate first aid for all cuts, scratches, abrasions, or other minor injuries.
- Report all accidents and near-misses, no matter how minor, to the FC.
- Be alert to your own and other workers' physical condition.
- Do not climb over or under obstacles of questionable stability.
- Make eye contact with equipment operators before moving into the range of their equipment.
- Work during daylight hours.

7 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

Appropriate PPE will be worn for all tasks as protection against potential hazards. Prior to donning PPE, the workers will inspect their equipment for any defects that might render the equipment ineffective.

All fieldwork for all tasks will be conducted in Level D or modified Level D as discussed in Sections 6.1, 6.2, and 6.3. Situations requiring PPE beyond modified Level D are not anticipated for this project. Should the FC determine that PPE beyond modified Level D is necessary at a given sampling station, the FC will notify the SSHO to select an appropriate corrective action.

7.1 Level D Personal Protective Equipment

Workers performing general activities in which skin contact with contaminated materials is unlikely and in which inhalation risks are not expected will wear Level D PPE. Level D PPE includes the following:

- Chemical-resistant, steel-toed boots
- Leather, cotton, or chemical-resistant gloves, as the type of work requires
- Safety glasses
- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

7.2 Modified Level D Personal Protective Equipment

Workers performing activities where skin contact with contaminated materials is possible will wear chemical-resistant outer gloves and an impermeable outer suit. The type of outerwear will be chosen according to the types of chemical contaminants that might be encountered. Modified Level D PPE includes the following:

- Outer garb such as rain gear or rubber or vinyl aprons
- Chemical-resistant steel-toed boots
- Surgical rubber inner gloves
- Chemical-resistant outer gloves
- Safety glasses (or face shield, if significant splash hazard exists)

-
- Hard hat (if overhead hazard exists)
 - Hearing protection, if necessary

7.3 Safety Equipment

In addition to PPE that will be worn by personnel, basic emergency and first aid equipment will also be provided and easily accessible in an unlocked location known to all personnel prior to the start of any activities. Equipment will include:

- A copy of this HASP
- First aid kit adequate for the number of personnel
- Emergency eyewash

Anchor QEA and/or subcontractors will provide this equipment, which must be at the location(s) where field activities are being performed. Equipment will be checked daily to ensure its readiness for use.

8 MONITORING PROCEDURES FOR SITE ACTIVITIES

A monitoring program that addresses the potential site hazards will be maintained. The monitoring program includes self-monitoring by the field personnel and monitoring with instruments.

8.1 Self Monitoring

All personnel will be instructed to look for and inform each other of any negative changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion (Section 4.3.7)
- Symptoms of hypothermia (Section 4.3.8)

If any of these conditions develop, the affected person(s) will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

8.2 Real-time Air Monitoring Equipment

Organic vapor concentrations shall be monitored in the field using an OVM, PID, or FID. During sampling and excavation work, organic vapor measurements shall be taken in the breathing zone of workers while additional area monitoring may be conducted to gather background and environmental impact information.

Other real-time air monitoring equipment may be utilized depending upon the scope of work and compounds of concern. Air monitoring results shall be documented on the air monitoring log form presented in Attachment 1.

The air monitoring scope and frequency may be adjusted based on air data obtained during the initial stages of a work task.

8.2.1 Equipment Calibration and Maintenance

Calibration and maintenance of air monitoring equipment shall follow manufacturer specifications and must be documented. Re-calibration and adjustment of air monitoring equipment shall be completed daily and as site conditions and equipment operation warrant. Records of air monitoring equipment calibration and adjustment information will be recorded in the field logbook or daily log form.

8.2.2 Air Monitoring Action Levels

Air monitoring action levels have been developed for this project and are listed in Table 2.

9 DECONTAMINATION

Decontamination is necessary to prevent the migration of contaminants from the work zone(s) into the surrounding environment and to minimize the risk of exposure of personnel to contaminated materials that might adhere to PPE. The following sections discuss personnel and equipment decontamination.

The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent (such as Alconox)
- Hexane or acetone (or similar type solution) for more robust equipment decontamination
- Scrub brushes and plastic tubs
- Distilled/deionized water
- Paper towels and plastic garbage bags

9.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials:

- Personnel:
 - Do not walk through spilled sediment or soil
 - Do not handle, touch, or smell sediment or soil directly
 - Make sure PPE has no cuts or tears prior to use
 - Protect and cover any skin injuries
 - Stay upwind of airborne dusts and vapors
 - Do not eat, drink, chew tobacco, or smoke in the work zones
- Sampling Equipment and Machinery:
 - Use care to avoid getting sampled media on the outside of sample containers
 - If necessary, bag sample containers before filling with sampled media
 - Place clean equipment on a plastic sheet to avoid direct contact with contaminated media
 - Keep contaminated equipment and tools separate from clean equipment and tools

-
- Fill sample containers over a plastic tub to contain spillage
 - Clean up spilled material immediately to avoid tracking around the drill rig

9.2 Personal Decontamination

The FC will ensure that all site personnel are familiar with personnel decontamination procedures. Personnel will perform decontamination procedures, as appropriate, when exiting work areas. Following is a description of the decontamination procedure:

- Wash and rinse outer gloves and boots in portable buckets
- If suit is heavily soiled, rinse it off
- Remove outer gloves, inspect and discard if damaged, leave inner gloves on
- Remove inner gloves and wash hands if taking a break
- Don necessary PPE before returning to work
- Dispose of soiled PPE before leaving for the day

10 TRAINING REQUIREMENTS

Individuals performing work at locations where potentially hazardous materials and conditions may be encountered must meet specific training requirements. It is not anticipated that personnel will encounter hazardous concentrations of contaminants in sampled material, so training will consist of site-specific instruction for all personnel and oversight of inexperienced personnel for one working day. The following sections describe the training requirements for work at this Site.

10.1 Project Specific Training

All Anchor QEA personnel must read this HASP and be familiar with its contents before beginning work. They shall acknowledge reading the HASP by signing the field team HASP review form contained in Attachment 4. The form will be kept in the project files.

The FC or a designee will provide and document project-specific training during the project kickoff meeting and whenever new Anchor QEA workers arrive for fieldwork. Anchor QEA personnel will not be allowed to begin work until project-specific training is completed and documented by the FC. Training will address the HASP and all health and safety issues and procedures pertinent to field operations. Training will include, but will not be limited to, the following topics:

- Activities with the potential for chemical exposure
- Activities that pose physical hazards, and actions to control the hazards
- Site access control and procedures
- Use and limitations of PPE
- Decontamination procedures
- Emergency procedures
- Use and hazards of sampling equipment
- Location of emergency equipment

All workers in the exclusion zone or CRZ must have 40-hour HAZWOPER training in accordance with OSHA. An updated 8-hour HAZWOPER refresher training is required for all workers in the exclusion zone or CRZ whose 40-hour HAZWOPER training certificate is more than one year old.

10.2 Daily Safety Briefings

The FC or a designee will conduct daily safety briefings before the start of each day's activities. These briefings will outline the activities expected for the day, update work practices and hazards, and address any specific concerns associated with the work location, and review emergency procedures and routes. The tailgate safety briefings will be documented in the logbook. A checklist of daily safety briefing topics will be conducted and supplemented with the following topics:

- Hazard Exposure Routes
- Chemical Hazards
- Physical Hazards
- Biological Hazards
- Mitigation Procedures
- Safety Communication
- Lines of Authority
- Description of first aid kit, including a discussion of usage (initial comprehensive training session and a brief daily overview)
- Near-water safety

A daily safety briefing log form is presented in Attachment 1.

11 RECORDING AND RECORD KEEPING

The FC or a designee will record health- and safety-related details of the project in the field logbook. The logbook must be bound and the pages must be numbered consecutively. Entries will be made with indelible ink. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all personnel
- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of fieldwork being performed

The person maintaining the entries will initial and date the bottom of each completed page. Blank space at the bottom of an incompletely filled page will be lined out. Each day's entries will begin on the first blank page after the previous workday's entries.

As necessary, other documentation will be obtained or initiated by the FC. Other documentation may include field change requests, medical and training records, exposure records, accident/incident report forms, OSHA Form 200s, and material safety data sheets. Attachment 1 contains copies of key health and safety forms.

12 HEALTH AND SAFETY PLAN APPROVAL RECORD

By their signature, the undersigned certify that this HASP is approved and that it will be used to govern health and safety aspects of fieldwork conducted by Anchor QEA personnel to investigate areas associated within the Site area.

Anchor QEA Project Manager

Date

Anchor QEA Site Supervisor

Date

Anchor QEA Site and Safety Health Officer

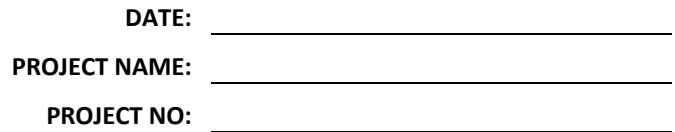
Date

13 REFERENCES

U.S. Environmental Protection Agency (EPA), 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA/823/B-01-022, October 2001.

ATTACHMENT 1

HEALTH AND SAFETY LOGS AND FORMS



PERSON CONDUCTING MEETING: _____ HEALTH & SAFETY OFFICER: _____ PROJECT MANAGER: _____

<input type="checkbox"/> Emergency Procedures and Evacuation Route	<input type="checkbox"/> Lines of Authority	<input type="checkbox"/> Lifting Techniques
<input type="checkbox"/> Directions to Hospital	<input type="checkbox"/> Communication	<input type="checkbox"/> Slips, Trips, and Falls
<input type="checkbox"/> HASP Review and Location	<input type="checkbox"/> Site Security	<input type="checkbox"/> Hazard Exposure Routes
<input type="checkbox"/> Safety Equipment Location	<input type="checkbox"/> Vessel Safety Protocols	<input type="checkbox"/> Heat and Cold Stress
<input type="checkbox"/> Proper Safety Equipment Use	<input type="checkbox"/> Work Zones	<input type="checkbox"/> Overhead and Underfoot Hazards
<input type="checkbox"/> Employee Right-to-Know/MSDS Location	<input type="checkbox"/> Vehicle Safety and Driving/Road Conditions	<input type="checkbox"/> Chemical Hazards
<input type="checkbox"/> Fire Extinguisher Location	<input type="checkbox"/> Equipment Safety and Operation	<input type="checkbox"/> Flammable Hazards
<input type="checkbox"/> Eye Wash Station Location	<input type="checkbox"/> Proper Use of PPE	<input type="checkbox"/> Biological Hazards
<input type="checkbox"/> Buddy System	<input type="checkbox"/> Decontamination Procedures	<input type="checkbox"/> Eating/Drinking/Smoking
<input type="checkbox"/> Self and Coworker Monitoring	<input type="checkbox"/> Other:	

1 of 1



DAILY AIR MONITORING RECORD

PROJECT NAME: _____ DATE: _____

PROJECT NUMBER: _____ LOCATION: _____

TEMPERATURE: _____

CONDITIONS: _____

COC	Instrument	S/N	Calibration Date	Calibration Gas/Method	Calibration by
Organic vapors					
Particulates					
O ₂					
Other:					
Other:					
Other:	Draeger				

Time	Location/Description	Organic Vapor (ppm)	O ₂ %	CG %LEL	Other	Other

Notes:

Completed by:

Printed Name

Signature

Date



EMPLOYEE EXPOSURE/INJURY INCIDENT/SPILL REPORT

EMPLOYEE NAME: _____ DATE: _____

PROJECT NAME/NO: _____ TIME: _____

TYPE OF OCCURRENCE: ☐ employee exposure ☐ injury incident ☐ spill

SITE NAME AND LOCATION: _____

SITE WEATHER (clear, rain, snow, etc.): _____

NATURE OF ILLNESS/INJURY: _____

SYMPTOMS: _____

ACTION TAKEN: ☐ rest ☐ first aid ☐ medical

TRANSPORTED BY: _____

WITNESSED BY: _____

HOSPITAL NAME: _____ TREATMENT: _____

DESCRIBE IN DETAIL HOW THIS EXPOSURE/INJURY INCIDENT/SPILL OCCURRED

(if a spill, list the name of the compounds, quantities, and method of clean-up/containment): _____

WHAT WAS THE PERSON DOING AT THE TIME OF THE ACCIDENT/INCIDENT?: _____

LIST PERSONAL PROTECTIVE EQUIPMENT WORN: _____

WHAT IMMEDIATE ACTION WAS TAKEN TO PREVENT RECURRENCE?: _____

Employee:

Printed Name Signature Date

Supervisor:

Printed Name Signature Date

Site Safety Representative:

Printed Name Signature Date

NOTE: Use additional page(s) if necessary.

ATTACHMENT 2

MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet



Agilent Technologies

EPA Methods 550/550.1/610 Polynuclear Aromatic Hydrocarbons (PAH) Standard PN: 8500-6035

1 . Product and company identification

Product name	: EPA Methods 550/550.1/610 Polynuclear Aromatic Hydrocarbons (PAH) Standard PN: 8500-6035
Part No.	: 8500-6035
Manufacturer / Supplier	: Agilent Technologies, Inc. Logistics Center - Americas 500 Ships Landing Way New Castle, Delaware 19720
Emergency telephone number	: 1-302-633-8777 1-877-4 Agilent (Information Telephone Number)
Use of the substance/preparation	: Analytical chemistry. A 1ml. ampoule preparation
Validation date	: 10/27/2009

2 . Hazards identification

Physical state	: Liquid. [Clear.]
Odor	: Ether-like
OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Emergency overview-Signal Word	: WARNING !
Emergency overview-Label Statement	: FLAMMABLE LIQUID AND VAPOR. HARMFUL IF INHALED. CAUSES EYE IRRITATION. MAY BE HARMFUL IF ABSORBED THROUGH SKIN OR IF SWALLOWED. MAY CAUSE RESPIRATORY TRACT AND SKIN IRRITATION. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA. Flammable liquid. Toxic by inhalation. Harmful in contact with skin and if swallowed. Irritating to eyes. Slightly irritating to the skin and respiratory system. Keep away from heat, sparks and flame. Avoid exposure - obtain special instructions before use. Do not breathe vapor or mist. Do not ingest. Do not get in eyes. Avoid contact with skin and clothing. Contains material that may cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling. Contains material which may cause damage to the following organs: kidneys, liver, cardiovascular system, upper respiratory tract, skin, central nervous system (CNS), eye, lens or cornea.
Routes of entry	: Dermal contact. Eye contact. Inhalation. Ingestion.
Potential acute health effects	
Eyes	: Irritating to eyes.
Skin	: Harmful in contact with skin. Slightly irritating to the skin.
Inhalation	: Toxic by inhalation. Slightly irritating to the respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
Ingestion	: Harmful if swallowed.
Medical conditions aggravated by over-exposure	: Repeated skin exposure can produce local skin destruction or dermatitis. Repeated or prolonged exposure to the substance can produce lung damage. Repeated or prolonged contact with spray or mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to the substance can produce target organs damage.
Other adverse effects	: Not applicable.

2 . Hazards identification

See toxicological information (section 11)

3 . Composition/information on ingredients

United States

<u>Name</u>	<u>CAS number</u>	<u>%</u>
Acetonitrile	75-05-8	99.2
Pyrene	129-00-0	0.05
Phenanthrene	85-01-8	0.05
Naphthalene	91-20-3	0.05
Indeno[1,2,3-cd]pyrene	193-39-5	0.05
Fluorene	86-73-7	0.05
Fluoranthene	206-44-0	0.05
Dibenz[a,h]anthracene	53-70-3	0.05
Chrysene	218-01-9	0.05
Benzo[k]fluoranthene	207-08-9	0.05
Benzo[ghi]perylene	191-24-2	0.05
Benz[e]acephenanthrylene	205-99-2	0.05
Benzo[a]pyrene	50-32-8	0.05
Benz[a]anthracene	56-55-3	0.05
Anthracene	120-12-7	0.05
Acenaphthylene	208-96-8	0.05
Acenaphthene	83-32-9	0.05

4 . First aid measures

- Eye contact** : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if adverse health effects persist or are severe.
- Skin contact** : In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention if adverse health effects persist or are severe.
- Inhalation** : If inhaled, remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention if adverse health effects persist or are severe.
- Ingestion** : Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention if adverse health effects persist or are severe.
- Protection of first-aiders** : Not applicable.
- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

5 . Fire-fighting measures

- Flammability of the product** : Flammable.
- Products of combustion** : Decomposition products may include the following materials:
carbon oxides
nitrogen oxides
- Extinguishing media**
- Suitable** : Use dry chemical, CO₂, water spray (fog) or foam.
- Not suitable** : Do not use water jet.
- Special exposure hazards - fire** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- Special exposure hazards - Explosibility** : Flammable liquid. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.

5 . Fire-fighting measures

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.
- Special remarks on fire hazards** : Container explosion may occur under fire conditions or when heated.

6 . Accidental release measures

- Personal precautions** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see section 8).
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Methods for cleaning up**
- Small spill** : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

7 . Handling and storage

- Handling** : Do not ingest. Avoid contact with eyes, skin and clothing. Keep container closed. Use only with adequate ventilation. Avoid breathing vapor or mist. Keep away from heat, sparks and flame. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Wash thoroughly after handling.
- Storage** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

8 . Exposure controls/personal protection

Product name

United States

Acetonitrile

Exposure limits

ACGIH TLV (United States, 1/2008). Skin

TWA: 20 ppm 8 hour(s).

NIOSH REL (United States, 6/2008).

TWA: 34 mg/m³ 10 hour(s).

TWA: 20 ppm 10 hour(s).

OSHA PEL (United States, 11/2006).

TWA: 70 mg/m³ 8 hour(s).

TWA: 40 ppm 8 hour(s).

OSHA PEL 1989 (United States, 3/1989).

STEL: 105 mg/m³ 15 minute(s).

STEL: 60 ppm 15 minute(s).

TWA: 70 mg/m³ 8 hour(s).

TWA: 40 ppm 8 hour(s).

Consult local authorities for acceptable exposure limits.

8 . Exposure controls/personal protection

Engineering measures	: No special ventilation requirements. Good general ventilation should be sufficient to control worker exposure to airborne contaminants. If this product contains ingredients with exposure limits, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure below any recommended or statutory limits.
Hygiene measures	: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Personal protection	
Eyes	: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
Skin	: Chemical resistant protective gloves and clothing are recommended. The choice of protective gloves or clothing must be based on chemical resistance and other use requirements. Generally, BUNA-N offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to this chemical may require additional protective clothing.
Respiratory	: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
Hands	: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
Other protection	: Not available.

9 . Physical and chemical properties

Physical state	: Liquid. [Clear.]
Flash point	: Lowest known value: Closed cup: 5.85°C (42.5°F). (Acetonitrile)
Auto-ignition temperature	: Lowest known value: 524°C (975.2°F) (Acetonitrile).
Color	: Clear. Colorless.
Odor	: Ether-like
Boiling/condensation point	: 81.6°C (178.9°F)
Melting/freezing point	: -45°C (-49°F)
Vapor pressure	: 11.6 kPa (87 mm Hg) (at 20°C)
Vapor density	: 1.42 (Air = 1)
Evaporation rate	: 5.79
Solubility	: Soluble in the following materials: cold water and hot water.

10 . Stability and reactivity

Stability and reactivity	: The product is stable. Under normal conditions of storage and use, hazardous polymerization will not occur.
Incompatibility with various substances	: Highly reactive or incompatible with the following materials: oxidizing materials, reducing materials, metals, acids, alkalis and moisture.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Conditions of reactivity - Flammability	: Highly flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and heat. Container explosion may occur under fire conditions or when heated.

11 . Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Acetonitrile	LD50 Dermal	Rabbit	980 mg/kg	-
	LD50 Oral	Rat	2460 mg/kg	-
	LC50 Inhalation	Rat	7551 ppm	8 hours
	Gas.			

- Eyes** : Irritating to eyes.
- Skin** : Harmful in contact with skin. Slightly irritating to the skin.
- Inhalation** : Toxic by inhalation. Slightly irritating to the respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
- Ingestion** : Harmful if swallowed.

Potential chronic health effects

- Chronic effects** : Contains material that may cause target organ damage, based on animal data.
- Carcinogenicity** : No known significant effects or critical hazards.
- Mutagenicity** : No known significant effects or critical hazards.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.

Over-exposure signs/symptoms

- Inhalation** : Adverse symptoms may include the following:
respiratory tract irritation
coughing
- Ingestion** : No specific data.
- Skin** : Adverse symptoms may include the following:
irritation
redness
- Eyes** : Adverse symptoms may include the following:
pain or irritation
watering
redness
- Target organs** : Contains material which may cause damage to the following organs: kidneys, liver, cardiovascular system, upper respiratory tract, skin, central nervous system (CNS), eye, lens or cornea.
- Other adverse effects** : Not available.

12 . Ecological information

- Environmental effects** : This product shows a low bioaccumulation potential.

Aquatic ecotoxicity

Product/ingredient name	Test	Result	Species	Exposure
Acetonitrile	-	Acute LC50 3600000 ug/L Fresh water	Daphnia	48 hours
	-	Acute LC50 >100000 ug/L Fresh water	Fish	96 hours

- Octanol/water partition coefficient** : -0.34
- Toxicity of the products of biodegradation** : The products of degradation are less toxic than the product itself.
- Other adverse effects** : No known significant effects or critical hazards.

13 . Disposal considerations

Waste disposal : The generation of waste should be avoided or minimized wherever possible. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.




RCRA classification : Code: U003

Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.


The information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.

14 . Transport information

Regulatory information	UN number	Proper shipping name	Class	PG*	Label	Additional information
DOT Classification	UN1648	Acetonitrile	3	II		<u>Limited quantity</u> Yes. <u>Packaging instruction</u> Passenger aircraft Quantity limitation: 5 L Packaging instructions: 173.161 Cargo aircraft Quantity limitation: 60 L <u>Special provisions</u> IB2, T7, TP2 <u>Remarks</u> Small Quantity
TDG Classification	UN1648	ACETONITRILE	3	II		<u>Explosive Limit and Limited Quantity Index</u> 1 <u>Passenger Carrying Road or Rail Index</u> 5
IMDG Class	UN1648	ACETONITRILE	3	II		<u>Emergency schedules (EmS)</u> F-E, S-D

14 . Transport information

IATA Class	UN1648	Acetonitrile	3	II		Passenger and Cargo Aircraft Quantity limitation: 5 L Packaging instructions: 305 Cargo Aircraft Only Quantity limitation: 60 L Packaging instructions: 307 Limited Quantities - Passenger Aircraft Quantity limitation: 1 L Packaging instructions: Y305 Remarks A44 Excepted Quantity
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PG* : Packing group

15 . Regulatory information

United States

HCS Classification

: Flammable liquid
 Toxic material
 Irritating material
 Target organ effects

Contains material which may cause damage to the following organs: kidneys, liver, cardiovascular system, upper respiratory tract, skin, central nervous system (CNS), eye, lens or cornea.

U.S. Federal regulations

: TSCA 4(a) final test rules: Acetonitrile; Naphthalene
 TSCA 8(a) CAIR: Pyrene; Phenanthrene
 TSCA 8(a) PAIR: Acetonitrile; Naphthalene
United States inventory (TSCA 8b): Not determined.
 TSCA 12(b) one-time export: Acetonitrile; Naphthalene

SARA 302/304/311/312 extremely hazardous substances: No products were found.

SARA 302/304 emergency planning and notification: No products were found.

SARA 302/304/311/312 hazardous chemicals: Acetonitrile

SARA 311/312 MSDS distribution - chemical inventory - hazard identification:

Acetonitrile: Fire hazard, Immediate (acute) health hazard, Delayed (chronic) health hazard

Clean Water Act (CWA) 307: Acetonitrile; Pyrene; Phenanthrene; Naphthalene; Indeno[1,2,3-cd]pyrene; Fluorene; Fluoranthene; Dibenz[a,h]anthracene; Chrysene; Benzo[k]fluoranthene; Benzo[ghi]perylene; Benz[e]acephenanthrylene; Benzo[a]pyrene; Benz[a]anthracene; Anthracene; Acenaphthylene; Acenaphthene

Clean Water Act (CWA) 311: Naphthalene

Clean Air Act (CAA) 112 accidental release prevention: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

SARA 313

Form R - Reporting requirements

Product name
 : Acetonitrile

CAS number
 75-05-8

Concentration
 99.2

Supplier notification

: Acetonitrile

75-05-8

99.2

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

15 . Regulatory information

State regulations

: **Connecticut Carcinogen Reporting:** None of the components are listed.
Connecticut Hazardous Material Survey: None of the components are listed.
Florida substances: None of the components are listed.
Illinois Chemical Safety Act: None of the components are listed.
Illinois Toxic Substances Disclosure to Employee Act: None of the components are listed.
Louisiana Reporting: None of the components are listed.
Louisiana Spill: None of the components are listed.
Massachusetts Spill: None of the components are listed.
Massachusetts Substances: The following components are listed: ACETONITRILE
Michigan Critical Material: None of the components are listed.
Minnesota Hazardous Substances: None of the components are listed.
New Jersey Hazardous Substances: The following components are listed:
 ACETONITRILE
New Jersey Spill: None of the components are listed.
New Jersey Toxic Catastrophe Prevention Act: None of the components are listed.
New York Acutely Hazardous Substances: The following components are listed:
 Acetonitrile
New York Toxic Chemical Release Reporting: None of the components are listed.
Pennsylvania RTK Hazardous Substances: The following components are listed:
 ACETONITRILE
Rhode Island Hazardous Substances: None of the components are listed.

State regulations - California Prop. 65

: **WARNING:** This product contains a chemical known to the State of California to cause cancer.

<u>Ingredient name</u>	<u>Cancer</u>	<u>Reproductive</u>	<u>No significant risk level</u>	<u>Maximum acceptable dosage level</u>
Pyrene	Yes.	No.	No.	No.
Phenanthrene	Yes.	No.	No.	No.
Naphthalene	Yes.	No.	Yes.	No.
Indeno[1,2,3-cd]pyrene	Yes.	No.	No.	No.
Fluoranthene	Yes.	No.	No.	No.
Dibenz[a,h]anthracene	Yes.	No.	Yes.	No.
Chrysene	Yes.	No.	0.35 µg/day (ingestion)	No.
Benzo[k]fluoranthene	Yes.	No.	No.	No.
Benzo[ghi]perylene	Yes.	No.	No.	No.
Benz[e]acephenanthrylene	Yes.	No.	0.096 µg/day (ingestion)	No.
Benzo[a]pyrene	Yes.	No.	Yes.	No.
Benz[a]anthracene	Yes.	No.	0.033 µg/day (ingestion)	No.
Anthracene	Yes.	No.	No.	No.
Acenaphthylene	Yes.	No.	No.	No.

16 . Other information

Label requirements

: FLAMMABLE LIQUID AND VAPOR. HARMFUL IF INHALED. CAUSES EYE IRRITATION. MAY BE HARMFUL IF ABSORBED THROUGH SKIN OR IF SWALLOWED. MAY CAUSE RESPIRATORY TRACT AND SKIN IRRITATION. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.

Date of issue : 10/27/2009

Date of previous issue : 09/28/2005

Version : 2

Notice to reader

16 . Other information

DISCLAIMER: This Material Safety Data Sheet is offered without charge to the clients of Agilent Technologies. Data is the most current available to Agilent Technologies at the time of preparation and is issued as a matter of information only, no warranty as to its accuracy or completeness is expressed or implied.

ATTACHMENT 3

JOB SAFETY ANALYSES

General Boating Activities

Project Name: Bremerton Gas Works RI/FS Marine Sampling	Project Number: 131014-01.01	JSA Number: 001	Issue Date: April 8, 2015
Location: Dyes Inlet, Bremerton, Washington	Contractor: Anchor QEA, LLC	Analysis by: Tracy Schuh	Analysis Date: April 8, 2015
Work Operation: General boating activities	Superintendent/Competent Person: Evan Malczyk	Revised by: N/A	Revised Date: N/A
Required Personal Protective Equipment (PPE): <ul style="list-style-type: none"> Modified Level D – Long pants or coveralls, steel-toed footwear conforming to American Society for Testing and Materials (ASTM) F2412-05/ASTM F2413-05, U.S. Coast Guard-approved personal flotation device Depending on activity, nitrile gloves, safety glasses and hard hat may also be required 		Reviewed by: Nathan Soccorsy	Reviewed Date: April 8, 2015
		Approved by: Nathan Soccorsy	Approved Date: April 8, 2015

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Walking on deck	Pinch points	<ul style="list-style-type: none"> Secure any unsecured objects on deck; they may shift on deck quickly in wave/current/engine acceleration conditions. Maintain safe distance from closing mechanisms and moving parts, such as on sampling gear. Avoid placing hands or self between boat and dock/piles. 	

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Slips, trips, and falls	<ul style="list-style-type: none"> Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. Maintain good housekeeping practices. Clean up all spills immediately. Be aware of weather effects on the work area, including wet ground. Jumping, running, and horseplay are prohibited. Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. Keep all areas clean and free of debris to prevent any trips and falls. Notify the field team members of any unsafe conditions. 	<ul style="list-style-type: none"> Routinely inspect work area for unsafe conditions.
Walking on deck (continued)	Exceeding boat capacity	<ul style="list-style-type: none"> Keep the number of passengers and equipment as posted on boat placards within limits at all times. If conditions warrant, reduce capacity to maintain boat stability. 	<ul style="list-style-type: none"> Ensure that field team is aware of limits and adheres accordingly.
	Noise exposure	<ul style="list-style-type: none"> Wear hearing protection in high noise environments or when working around heavy machinery/equipment (action level of 85 decibels averaged over an 8-hour day). 	<ul style="list-style-type: none"> Ensure that hearing protection is available.
Working outdoors	Heat stress	<ul style="list-style-type: none"> Adjust work schedules, as necessary, to avoid hottest part of the day. Take rest breaks as warranted. Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. Maintain body fluids at normal levels. Train workers to recognize the symptoms of heat-related illness. 	<ul style="list-style-type: none"> Monitor workers' physical conditions. Monitor outside temperature versus worker activity.
	Rain	<ul style="list-style-type: none"> Wear appropriate PPE (rain gear). Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. 	<ul style="list-style-type: none"> PPE should be inspected daily prior to use. Routinely inspect work area for deteriorating conditions.

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors (continued)	Sunshine	<ul style="list-style-type: none"> Have sunscreen available for ultraviolet protection. Have abundant water available to prevent dehydration. Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing. 	<ul style="list-style-type: none"> Ensure that sunscreen and water are on board.
	Fog	<ul style="list-style-type: none"> Wait for fog to lift for adequate visibility. 	
	Lightning	<ul style="list-style-type: none"> Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment. Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm. 	<ul style="list-style-type: none"> Obtain weather forecast and updates as needed.
	High river flows or high waves	<ul style="list-style-type: none"> Be aware of waves and forecasts and recent rainfall in your watershed. 	<ul style="list-style-type: none"> Have forecast available.
	High winds	<ul style="list-style-type: none"> Wear goggles or safety glasses if dust/debris is visible. 	<ul style="list-style-type: none"> Ensure that goggles/safety glasses are on board.
Vessel emergencies	Man overboard	<ul style="list-style-type: none"> Shout “man overboard,” throw flotation device, keep engine away from person, and call 911 or USCG if needed. 	<ul style="list-style-type: none"> Ensure that flotation devices are available. Ensure that team wears PFDs.
Vessel emergencies (continued)	Fire, abandon ship	<ul style="list-style-type: none"> Be prepared to abandon ship in case of major fire or other emergency. Only the captain can order abandon ship. Communicate intent to abandon to all personnel; notify USCG and nearby vessels. Call 911 when able to do so; notify project safety personnel when time permits. 	<ul style="list-style-type: none"> Ensure that fire extinguisher is available/current and is in working order. Review abandon ship procedures with field team prior to work.
Navigation	Boat traffic	<ul style="list-style-type: none"> Maintain a safe operating distance from shoreline and other vessels. 	<ul style="list-style-type: none"> Be aware of on-water surroundings.

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Motor vehicle operation and trailering	Boat not secured properly	<ul style="list-style-type: none">• Ensure that latches, straps, antennas, and onboard gear are secure.• Ensure that motor is up and lights are plugged in for driving.• Follow Job Safety Analysis (JSA) for motor vehicle operation	<ul style="list-style-type: none">• Inspect around entire boat before driving.

Training Requirements

- If professional captained vessel is not in use, boat operators must take appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Sediment Sampling

Project Name: Bremerton Gas Works RI/FS Marine Sampling	Project Number: 131014-01.01	JSA Number: 002	Issue Date: April 8, 2015
Location: Dyes Inlet, Bremerton, Washington	Contractor: Anchor QEA, LLC	Analysis by: Tracy Schuh	Analysis Date: April 8, 2015
Work Operation: Sediment sampling	Superintendent/Competent Person: Evan Malczyk	Revised by: N/A	Revised Date: N/A
Required Personal Protective Equipment (PPE): <ul style="list-style-type: none"> Modified Level D – Long pants or coveralls, steel-toed footwear conforming to American Society for Testing and Materials (ASTM) F2412-05/ASTM F2413-05, nitrile gloves, U.S. Coast Guard-approved personal flotation device, safety glasses Depending on activity, hard hat may also be required 		Reviewed by: Nathan Soccorsy	Reviewed Date: April 8, 2015
		Approved by: Nathan Soccorsy	Approved Date: April 8, 2015

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		<ul style="list-style-type: none"> Follow Job Safety Analysis (JSA) for boating activities. 	
Sediment sample retrieval and processing	Injury from hand and power tool operation (e.g., electric shears or drill)	<ul style="list-style-type: none"> Be aware of sharp edges on hand tools (e.g., knives, drill bits, and saw blades). Be aware of electrical connections and water hazards when working with electric- or battery-operated tools. Ensure that all tools are working properly; repair or replace defective tools. Repair when unplugged and off. Keep guards on power tools when not in use. 	<ul style="list-style-type: none"> Inspect tools to ensure that they're in good working order. Inspect electrical connections (if applicable). Inspect tools periodically to ensure dry and clean operation.
	Noise exposure	<ul style="list-style-type: none"> Wear hearing protection in high noise environments or when working around heavy machinery/equipment (action level of 85 decibels averaged over an 8-hour day). 	<ul style="list-style-type: none"> Ensure that hearing protection is available.

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Sediment sample retrieval and processing (continued)	Slips, trips, and falls	<ul style="list-style-type: none"> Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. Maintain good housekeeping practices. Clean up all spills immediately. Be aware of weather effects on the work area, including wet ground. Jumping, running, and horseplay are prohibited. Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. Keep all areas clean and free of debris to prevent any trips and falls. Notify the field team members of any unsafe conditions. 	<ul style="list-style-type: none"> Routinely inspect work area for unsafe conditions.
	Ingestion of contaminants, skin/eye contact with contaminants	<ul style="list-style-type: none"> Wear appropriate PPE to prevent/reduce exposure. Contact 911, as necessary; perform CPR if breathing stops. Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. Follow decontamination procedures as outlined in the HASP. 	<ul style="list-style-type: none"> Ensure that decontamination procedures are on hand and are reviewed. Ensure that PPE and rinsing water are available.
	Muscle strain/injuries from improper lifting	<ul style="list-style-type: none"> Use proper lifting techniques or ask for assistance with heavy objects. If boating, avoid carrying objects directly onto or off the boat; rather, load/unload objects while on the boat to/from the pier/shore. 	<ul style="list-style-type: none"> Evaluate weight and center of gravity of heavier items prior to lifting/moving.
	Pinch points	<ul style="list-style-type: none"> If boating, secure any unsecured objects on deck; they may shift on deck quickly in wave/current/engine acceleration conditions. Maintain safe distance from closing mechanisms and moving parts on sampling gear. Avoid placing hands or self between boat and dock/piles. 	

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors	Heat stress	<ul style="list-style-type: none"> Adjust work schedules, as necessary, to avoid hottest part of the day. Take rest breaks as warranted. Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. Maintain body fluids at normal levels. Train workers to recognize the symptoms of heat-related illness. 	<ul style="list-style-type: none"> Monitor workers' physical conditions. Monitor outside temperature versus worker activity.
Working outdoors (continued)	Rain	<ul style="list-style-type: none"> Wear appropriate PPE (rain gear). Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. 	<ul style="list-style-type: none"> PPE should be inspected daily prior to use. Routinely inspect work area for deteriorating conditions.
	Sunshine	<ul style="list-style-type: none"> Have sunscreen available for ultraviolet protection. Have abundant water available to prevent dehydration. Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing. 	<ul style="list-style-type: none"> Ensure that sunscreen and water are available.
	Lightning	<ul style="list-style-type: none"> Do not begin or continue work until lightning subsides for 20 minutes. Disconnect and do not use or touch electronic equipment. Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm. 	<ul style="list-style-type: none"> Obtain weather forecast and updates as needed.
	High winds	<ul style="list-style-type: none"> Wear goggles or safety glasses if dust/debris is visible. 	<ul style="list-style-type: none"> Ensure that goggles/safety glasses are available.

Training Requirements

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).

Sediment Sampling

- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Water Sampling

Project Name: Bremerton Gas Works RI/FS Marine Sampling	Project Number: 131014-01.01	JSA Number: 003	Issue Date: April 8, 2015
Location: Dyes Inlet, Bremerton, Washington	Contractor: Anchor QEA, LLC	Analysis by: Tracy Schuh	Analysis Date: April 8, 2015
Work Operation: Water sampling	Superintendent/Competent Person: Evan Malczyk	Revised by: N/A	Revised Date: N/A
Required Personal Protective Equipment (PPE): <ul style="list-style-type: none"> Modified Level D – Long pants or coveralls, steel-toed footwear conforming to American Society for Testing and Materials (ASTM) F2412-05/ASTM F2413-05, nitrile gloves, U.S. Coast Guard-approved personal flotation device, safety glasses Depending on activity, hard hat may also be required 		Reviewed by: Nathan Soccorsy	Reviewed Date: April 8, 2015
		Approved by: Nathan Soccorsy	Approved Date: April 8, 2015

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		<ul style="list-style-type: none"> Follow Job Safety Analysis (JSA) for boating activities. 	
Water sample retrieval	Slips, trips, and falls	<ul style="list-style-type: none"> Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. Maintain good housekeeping practices. Clean up all spills immediately. Be aware of weather effects on the work area, including wet and/or frozen ground. Jumping, running, and horseplay are prohibited. Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. Keep all areas clean and free of debris to prevent any trips and falls. Notify the field team members of any unsafe conditions. 	<ul style="list-style-type: none"> Routinely inspect work area for unsafe conditions.

Water Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Water sample retrieval (continued)	Ingestion of contaminants, skin/eye contact with contaminants	<ul style="list-style-type: none"> Wear appropriate PPE to prevent/reduce exposure. Contact 911, as necessary; perform CPR if breathing stops. Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. Follow decontamination procedures as outlined in the HASP. 	<ul style="list-style-type: none"> Ensure that decontamination procedures are on hand and are reviewed. Ensure that PPE and rinsing water are available.
	Pinch points	<ul style="list-style-type: none"> If boating, secure any unsecured objects on deck; they may shift on deck quickly in wave/current/engine acceleration conditions. Maintain safe distance from closing mechanisms and moving parts on sampling gear. If boating, avoid placing hands or self between boat and dock/piles. 	
	Muscle strain/injuries from improper lifting	<ul style="list-style-type: none"> Use proper lifting techniques or ask for assistance with heavy objects, buckets, or other unwieldy equipment. If boating, avoid carrying objects directly onto or off of the boat; rather, load/unload objects while on the boat to/from the pier/shore. 	<ul style="list-style-type: none"> Evaluate weight and center of gravity of heavier items prior to lifting/moving.
	Noise exposure	<ul style="list-style-type: none"> Wear hearing protection in high noise environments or when working around heavy machinery/equipment (action level of 85 decibels averaged over an 8-hour day). 	<ul style="list-style-type: none"> Ensure that hearing protection is available.
Working outdoors	Heat stress	<ul style="list-style-type: none"> Adjust work schedules, as necessary, to avoid hottest part of the day. Take rest breaks as warranted. Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. Maintain body fluids at normal levels. Train workers to recognize the symptoms of heat-related illness. 	<ul style="list-style-type: none"> Monitor workers' physical conditions. Monitor outside temperature versus worker activity.

Water Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Rain	<ul style="list-style-type: none"> Wear appropriate PPE (rain gear). Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. 	<ul style="list-style-type: none"> PPE should be inspected daily prior to use. Routinely inspect work area for deteriorating conditions.
	Sunshine	<ul style="list-style-type: none"> Have sunscreen available for ultraviolet protection. Have abundant water available to prevent dehydration. Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing. 	<ul style="list-style-type: none"> Ensure that sunscreen and water are available.
	Lightning	<ul style="list-style-type: none"> Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment. Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm. 	<ul style="list-style-type: none"> Obtain weather forecast and updates as needed.
	High winds	<ul style="list-style-type: none"> Wear goggles or safety glasses if dust/debris is visible. 	<ul style="list-style-type: none"> Ensure that goggles/safety glasses are available.

Training Requirements

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Beach Sampling

Project Name: Bremerton Gas Works RI/FS Marine Sampling	Project Number: 131014-01.01	JSA Number: 004	Issue Date: April 8, 2015
Location: Dyes Inlet, Bremerton, Washington	Contractor: Anchor QEA, LLC	Analysis by: Tracy Schuh	Analysis Date: April 8, 2015
Work Operation: Beach sampling	Superintendent/Competent Person: Evan Malczyk	Revised by: N/A	Revised Date: N/A
Required Personal Protective Equipment (PPE): <ul style="list-style-type: none"> Modified Level D – Long pants or coveralls, steel-toed footwear conforming to American Society for Testing and Materials (ASTM) F2412-05/ASTM F2413-05, nitrile gloves, U.S. Coast Guard-approved personal flotation device, safety glasses Depending on activity, hard hat may also be required 		Reviewed by: Nathan Soccorsy	Reviewed Date: April 8, 2015
		Approved by: Nathan Soccorsy	Approved Date: April 8, 2015

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		<ul style="list-style-type: none"> Follow Job Safety Analysis (JSA) for boating activities. 	
Shellfish sample retrieval	Slips, trips, and falls	<ul style="list-style-type: none"> Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. Maintain good housekeeping practices. Clean up all spills immediately. Be aware of weather effects on the work area, including wet and/or frozen ground. Jumping, running, and horseplay are prohibited. Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. Keep all areas clean and free of debris to prevent any trips and falls. Notify the field team members of any unsafe conditions. 	<ul style="list-style-type: none"> Routinely inspect work area for unsafe conditions.

Beach Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Shellfish sample retrieval (continued)	Ingestion of contaminants, skin/eye contact with contaminants	<ul style="list-style-type: none"> Wear appropriate PPE to prevent/reduce exposure. Contact 911, as necessary; perform CPR if breathing stops. Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. Follow decontamination procedures as outlined in the HASP. 	<ul style="list-style-type: none"> Ensure that decontamination procedures are on hand and are reviewed. Ensure that PPE and rinsing water are available.
	Pinch points	<ul style="list-style-type: none"> If boating, secure any unsecured objects on deck; they may shift on deck quickly in wave/current/engine acceleration conditions. Maintain safe distance from closing mechanisms and moving parts on sampling gear. If boating, avoid placing hands or self between boat and dock/piles. 	
	Muscle strain/injuries from improper lifting	<ul style="list-style-type: none"> Use proper lifting techniques or ask for assistance with heavy objects, buckets, or other unwieldy equipment. If boating, avoid carrying objects directly onto or off of the boat; rather, load/unload objects while on the boat to/from the pier/shore. 	<ul style="list-style-type: none"> Evaluate weight and center of gravity of heavier items prior to lifting/moving.
	Noise exposure	<ul style="list-style-type: none"> Wear hearing protection in high noise environments or when working around heavy machinery/equipment (action level of 85 decibels averaged over an 8-hour day). 	<ul style="list-style-type: none"> Ensure that hearing protection is available.
Working outdoors	Heat stress	<ul style="list-style-type: none"> Adjust work schedules, as necessary, to avoid hottest part of the day. Take rest breaks as warranted. Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. Maintain body fluids at normal levels. Train workers to recognize the symptoms of heat-related illness. 	<ul style="list-style-type: none"> Monitor workers' physical conditions. Monitor outside temperature versus worker activity.

Beach Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Rain	<ul style="list-style-type: none"> Wear appropriate PPE (rain gear). Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. 	<ul style="list-style-type: none"> PPE should be inspected daily prior to use. Routinely inspect work area for deteriorating conditions.
	Sunshine	<ul style="list-style-type: none"> Have sunscreen available for ultraviolet protection. Have abundant water available to prevent dehydration. Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing. 	<ul style="list-style-type: none"> Ensure that sunscreen and water are available.
	Lightning	<ul style="list-style-type: none"> Do not begin or continue work until lightning subsides for at least 20 minutes. Disconnect and do not use or touch electronic equipment. Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm. 	<ul style="list-style-type: none"> Obtain weather forecast and updates as needed.
	High winds	<ul style="list-style-type: none"> Wear goggles or safety glasses if dust/debris is visible. 	<ul style="list-style-type: none"> Ensure that goggles/safety glasses are available.

Training Requirements

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Motor Vehicle Operation

Project Name: Bremerton Gas Works RI/FS Marine Sampling	Project Number: 131014-01.01	JSA Number: 005	Issue Date: April 8, 2015
Location: Dyes Inlet, Bremerton, Washington	Contractor: Anchor QEA, LLC	Analysis by: Tracy Schuh	Analysis Date: April 8, 2015
Work Operation: Motor vehicle operation	Superintendent/Competent Person: Evan Malczyk	Revised by: N/A	Revised Date: N/A
Required Personal Protective Equipment (PPE): • None		Reviewed by: Nathan Soccorsy	Reviewed Date: April 8, 2015
		Approved by: Nathan Soccorsy	Approved Date: April 8, 2015

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Motor vehicle operation	New/unfamiliar vehicle	<ul style="list-style-type: none"> Allow yourself some time to get familiar with a rental vehicle or one not used very often. Test lights, windshield wipers, hazard lights, horn, and parking brake, and other important functions. Allow extra side, front, and back space around the vehicle while driving or parking an unfamiliar vehicle. Adjust mirrors and seat while vehicle is in park. 	<ul style="list-style-type: none"> Become familiar with important operating functions and space requirements for the vehicle.
	Vehicle accident	<ul style="list-style-type: none"> Plan your travel route and avoid rush hour(s) if possible. Obey traffic laws. Use care when backing up; back up slowly and use a spotter for difficult locations or poor lighting, or while trailering. Drive defensively and park in parking spaces uncrowded by other vehicles. If an accident occurs, stay in the car and call for help. 	<ul style="list-style-type: none"> Ensure that insurance information is in the vehicle.

Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Motor vehicle operation (continued)	Distraction while driving	<ul style="list-style-type: none"> Stop driving if a potential for a distracting conversation exists. Do not use cell phones or GPS while driving; ask your colleagues to assist you, or safely pull over to use if you are alone. 	
	Fatigue/falling asleep	<ul style="list-style-type: none"> Get adequate rest prior to driving. If feeling slightly tired, change seat position, open windows, and stretch often. If experiencing extreme drowsiness or fatigue, pull over to a safe place and rest. 	
	Weather/road conditions	<ul style="list-style-type: none"> Check road and weather conditions on route before traveling; be prepared to adjust and have a plan for alternate stops or travel if conditions change. Travel in daylight hours when possible. Allow extra time for delays so that you do not feel rushed. For road glare, consider wearing sunglasses and use caution particularly when driving during sunrise or sunset. 	<ul style="list-style-type: none"> Ensure that windshield wipers are in good working order and washer fluid is adequate. Check tires for adequate tread for road conditions.

Training Requirements

- All assigned employees are required to familiarize themselves with the contents of this Job Safety Analysis (JSA) before starting a work activity and review it with their supervisor during their daily safety meeting.

ATTACHMENT 4

SAFETY RECORD FORMS

I have read a copy of the HASP, which covers field activities that will be conducted to investigate specified areas on and adjacent to the Former Bremerton MGP Site in Bremerton, Washington. I understand the health and safety requirements of the project, which are detailed in this HASP.

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